AMERICAN ENGINEER
CAR BUILDER AND RAILROAD JOURNAL.

FEBRUARY, 1898.

CONTENTS.

ILLUSTRATED ARTICLES:	Page
Concord Shops—Boston & Maine Railroad, with Inset	37
Locomotives with Piston Valves—Norfolk & Western Railway	38
New Postal Cars—Chicago & Alton Railroad	43
A Rope Drive in a Railroad Shop	45
70,000-Pound Coal Cars—N. P. Railway	46
Eight-Wheel Locomotives for Japan	48
Q & C Scott Boiler Feeder	48
80,000-Pound Coal Cars—C. & E. I. Railroad	50
Powerful Locomotives—Great Northern Railway	51
Combination Electric Construction Car	52
The Black Diamond Truck	53
Brackin Pipe Wrench	67
Malleable Iron Brake Forks	62
Tonnage Rating	66
MISCELLANEOUS ARTICLES:	
Terms of Steam Engine Efficiency	41
English Opinion on American Fast Trains	41
Continuous Rope Driving	43
Compound Locomotives	44
Yarrow on American Machinery	44

MISCELLANEOUS ARTICLES:	Page
Dangers in Annealing	45
Baltimore & Ohio Presidents	47
Sanitation of Cars	52
Wastefulness of Auxiliary Engines	53
Engineering Notes	57
Personals	59
Books and Pamphlets	60
Pooling Locomotives and Locomotive Crews	63
New 10-Wheel Locomotives—Northern Pacific Railway	65
The National Association of Manufacturers	67
The Cleaning of Triple Valves	68
Railway Signaling Club	68
Subjects for M. C. B. Conventions	69
Track Improvements on Great Northern Railway	69
Pennsylvania Limited	69
Equipment and Manufacturing	70
EDITORIALS:	
The Value of New Machine Tools	54
Duration of Locomotive Boiler Tests	54
Pooling Locomotives	54
Height of Drawbars	55
Brake Shoe Testing Machine	55
The Advantage of Steel Cars	55
The Atlantic City Flyer	57

ANNOUNCEMENT.

A series of articles on the Construction of a Modern Locomotive, by a motive power officer of one of the leading railroads of this country, will commence in our March number, and will treat the subject in a practical manner from the ordering of the material to the testing of the finished locomotive. This will be a valuable record, based upon a wide practical experience, and as only a limited number of extra copies will be printed, you are urged to subscribe before the publication of the March issue.

CONCORD SHOPS—BOSTON & MAINE RAILROAD.

[WITH AN INSET.]

The tendency in all manufacturing enterprises is toward consolidation of work and of management for the purpose of economizing in operation. In railroad as well as in manufacturing shop practice this appears in the concentration of the work requiring special facilities at points where such facilities may best be provided and most satisfactorily operated. There is good business management in the plan that contemplates a few well equipped shops rather than a much larger number of less complete and less convenient plants, the number of which renders completeness too expensive for consideration. it may be considered significant that an important Western road, when installing a new hydraulic riveting plant, made it large enough to do the heavy boiler and firebox work for the locomotives of the entire road and upon this basis a large expenditure was warranted. There appears to be a strong tendency in this direction, though for several years very few large shops have been built.

The new shops of the Boston & Maine Railroad at Concord, N. H., are particularly interesting for these and for several other reasons. The buildings, except the storehouse and offices, are all of one-story. They are arranged with a view of convenience in handling material and of furnishing light to the workmen; the buildings are separated as much as consistent with convenience for the purpose of reducing the fire risks, and provisions are made for the future extension of every building. The most noteworthy feature, however, is the concentration of the steam plant into one building and the distribution of power by electricity. This part of the work will be taker up in detail later in connection with the power house and machine shops and the cranes for handling the locomotive work. The general plan and sections of some of the buildings are illustrated by means of the supplement accompanying this issue. Mr. Henry Bartlett, superintendent of motive power of the road, kindly furnished the drawings and the information given in this description, which is published simultaneously in the "American Engineer" and the "Railroad Gazette" by special arrangement.

The shops are situated about a half mile south of the station at Concord, occupying a level plot of 26 acres extending along the west side of the main tracks. There are three main tracks at this point and a fourth gives access to the yard at Concord without the danger of delay by the occupation of the main tracks. The repair work of the Concord, the White Mountains, the Worcester, Nashua & Portsmouth and that of a part of the Southern divisions will be done here. The number of locomotives cared for will be about 300. The capacity of the car shops is about 400 freight cars and 50 passenger cars per month. The buildings alone occupy 4.63 acres of ground.

As shown in the large general plan of the grounds the tracks are arranged to give access to the shop yard at the centre and at each end and, by means of switch connections, the whole yard is accessible for locomotives. As stated, the buildings, with the exception of the store house, are all of one story—with the exception of the lumber shed they are all of brick. The roofs of the paint shop, the lumber shed, the car repair shops and the oil storehouse are all of gravel, while those of the other buildings are of sheet steel, with standing seams. The buildings are all provided with ends that may be removed, for the purpose of easy extension, when this becomes necessary. It will be noted that the location of the buildings provides for extension in length in either direction. This is an important matter to which special attention is directed.

The locomotive shop is at the north end of the plant, the main portion of the building being 305 by 130 feet, to which an extension 105 by 70 feet is added for the boiler and tank shop. This arrangement permits of running the locomotive cranes from the main locomotive shop directly into the boiler and tank shop, the advantage of which is at once apparent. The erecting shop has three longitudinal tracks, the central one of which runs through the building and through the boiler shop as well. Upon this track the engines will be dismantled, and the two 30-ton Sellers traversing cranes will take them to the work tracks on either side of the central track. All three tracks are provided with pits for work under the engines. The machine shops are in the wings of the building, and are therefore near the work. This building will be illustrated later. It should be stated that the three longitudinal tracks offer the advantages of avoiding the expense and trouble of operating a transfer table as well as saving the space occupied by the pit, which would be required for the transverse track arrangement; also with transverse tracks one very heavy crane would be required for raising locomotives, and it could not be so conveniently used for light work as are the two lighter cranes of the longitudinal track plan. With two cranes available for work in different parts of the building, when not required for handling engines or boilers, the general work of the shop may be facilitated. The crane service of such a plant is an exceedingly important matter, as it affects the cost of all of the heavy work and much of the lighter work; in fact, it is believed that more may be saved by installing efficient crane machinery than most people imagine. It is interesting to observe the contrast between most railroad shops and contract building establishments in this particular.

The wash building, near the locomotive shop, is 62 feet by 26 feet in size, and accommodates 150 men at once. This building is for the men in the locomotive and blacksmith shops, and is so placed as to be conveniently in the path from these shops to

the gate of the grounds. The north end of this building contains tanks for removing the grease from the running gear of the locomotives, a brick partition separating the parts of the building. An attendant looks after the sanitary and mechanical work of the building. West of the wash house is the lumber shed, a frame building, 300 by 40 feet, with a track on each side. This building is removed as far as possible from the other buildings to reduce the fire risk. It has a storage capacity for about 500,000 feet of lumber.

The store house is a two-story building 100 feet by 40 feet, and is accessible from two tracks, and also from a roadway for teams. The lower floor, as shown in the plan, has three platforms, one for unloading from teams and two for unloading from freight cars. A receiving and shipping room is provided at the north end, adjoining which is the store room for heavy material. A counter separates the store room from the vestibule at the south end, and the office for the storekeper is in one corner of the building. The racks for the stores are adjustable, and like the rest of the interior of the building are of hard pine, with natural finish. In the upper story are the offices of the master mechanic and of the car department. At the north end of this floor is a large storage room for light stores, with independent stairs to the lower store room.

The blacksmith shop is opposite the store house. It is 100 by 60 feet, and has ten double forges and one large forge. There are four power hammers, two Bement and Miles steam hammers, one 1,200 pounds and the other 1,800 pounds, one Dupont belted hammer of 250 pounds and one Hotchkiss steam hammer of about 500 pounds. A bolt header, power shear and drill press were also located in this building. A 15-horse power Westinghouse motor mounted on the roof trusses drives the blower and the exhauster and a 20 horse power motor on the ground drives the other machinery.

The next group of buildings are the dry house, the planing mill, boiler and power house (combined in one building) and the small shops. The dry house is 75 by 25 feet, and is near the planing mill. Its floor is of old rails, and the steam piping is contained in an excavation about three feet deep below the floor. In this 8,000 feet of 1 1-2 inch piping is placed and divided into eight sections in order to permit of regulating the amount of heat. A section of this building illustrates its arrangement. The planing mill and power house join at their ends. The walls are of brick, and the roof trusses of the power house are of iron, while those of the mill are of timber. The mill is 300 by 60 feet and the power and boiler house is 111 by 65 feet. All of the engines, dynamos and boilers of the plant are concentrated here, and power is distributed to motors in the shops and to the transfer table. The whole plant is also heated and lighted from this point, the system being sufficiently interesting to warrant taking it up in detail in a future issue.

The cabinet, pattern, buffing, tin and pipe shops are all under one roof in a building 200 by 40 feet, to which power is carried to drive a 5 horse-power Westinghouse motor. South of these buildings is a hand transfer table for light service for the car shops and the planing mill.

The freight and passenger repair shops are in one building, 323 by 170 feet, divided in the center by a fire wall. The freight-car work is done at the west end where thirty-two cars may be repaired at once. The passenger-car repair shop accommodates sixteen cars. These shops are well lighted and ventilated.

The transfer table is located south of the car repair shops, and is sufficiently removed from the buildings on each side to allow cars to stand between the pit and the buildings, the space provided being 82 feet on each side. The pit is 280 by 70 feet, and the table connects with the tracks leading directly from the locomotive shop. The table, which operates from an overhead trolley, was furnished by the Industrial Works of Bay City, Mich. It is provided with winches, and the machinery is housed.

South of the transfer table is the paint shop, which is 238 by 165 feet, and has space for sixteen passenger cars and four locomotives. At the east end of this building are the varnish and upholstery rooms, each 81 by 36 feet, divided from the main shop by a brick wall. The last building at the south end of the plant is the paint and oil store house, a building 50 by 25 feet, with a cellar and arched floor.

The buildings are arranged with a view of avoiding unnecessary transportation of material, and those containing the machinery are so planned as to permit all work of one kind to be kept together. The electrical distribution will be described later; also the steam distribution system. The steam, water and air pipes are carried through closed trenches to the various building, and are located as shown in the general plan of the shops and grounds. The drainage system is very complete, and is connected with the city sewer, a branch of which passes through the grounds. The locations of the drains are also indicated on the plan. The compressed air piping is carried through the locomotive and car shops and yards, the power being furnished by an 8 by 12 inch, duplex compressor furnished by the Rand Drill Company. The waterworks are connected with the city mains and there are two lines of water pipes—one for fire service, carrying 110 pounds per square inch and the other for shop use, carrying 90 pounds.

The entire plant is heated by the fan system, furnished by the Boston Blower Company, of Boston, Mass., on a guarantee to maintain the following temperatures in zero weather: Car repair shops, 65 degrees; planing mill, 65 degrees; cabinet and pattern shops, 70 degrees; small shops, 65 degrees; locomotive and boiler shops 65 degrees; paint and varnish shops, 75 degrees; paint and oil store, 65 degrees. The blower and exhauster in the blacksmith shop and the smoke fan for artificial draft in the power house were furnished by the same company.

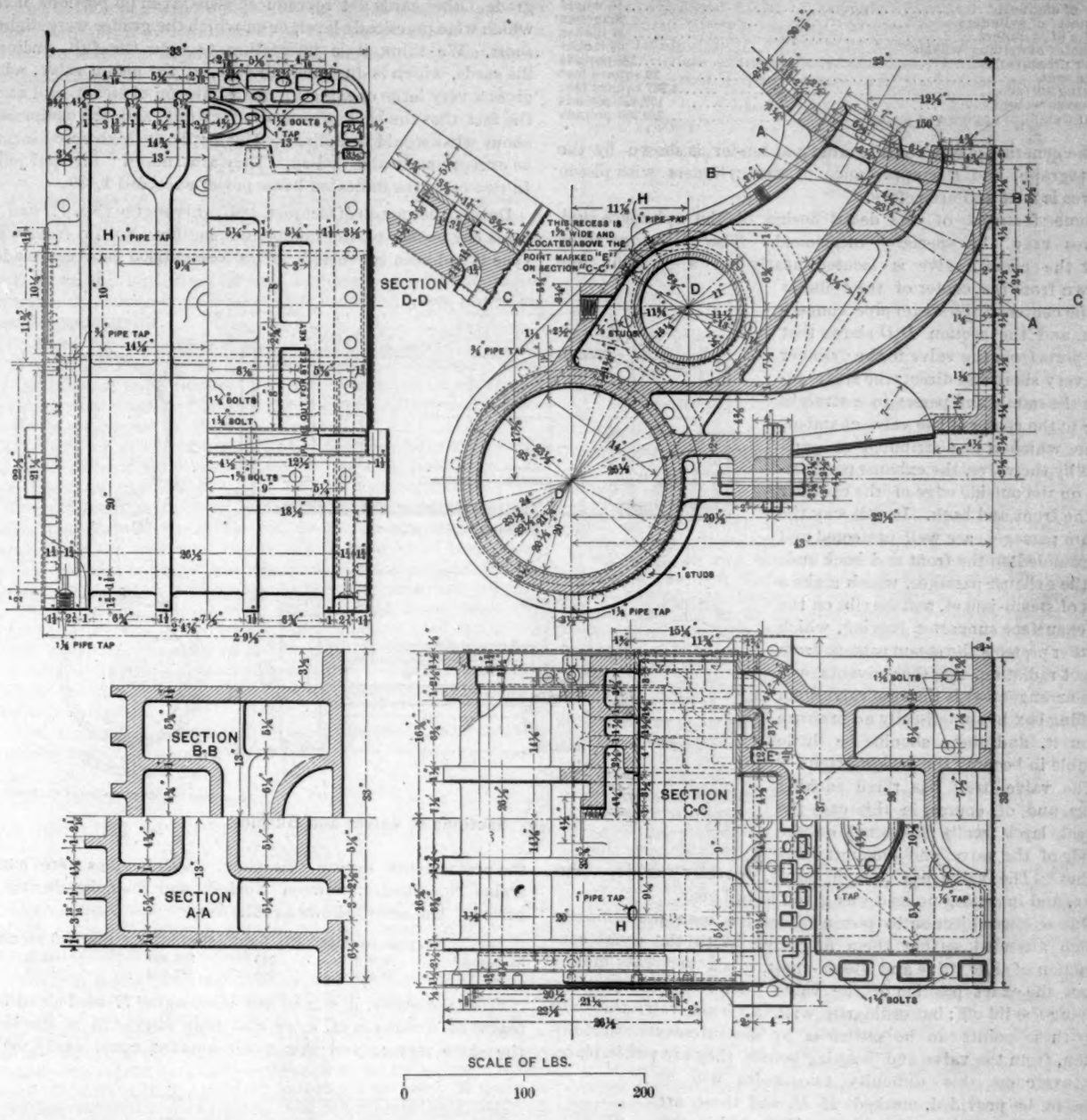
The plans, specifications and details of the arrangement of the mechanical features were drawn up by the motive power and car departments of the road, and the plans and specifications of the buildings were prepared in the Chief Engineer's department. The contractors were as follows: Buildings, Messrs. Mead, Mason & Co., of Boston; iron work, the New England Structural Works, Boston; shafting, Somersworth Machine Co., Boston; electric machinery, the Westinghouse Electric and Manufacturing Company, Pittsburgh; steam and air piping, Coffin & Co., Boston; heating, the Boston Blower Company, Boston; transfer table, Industrial Works, Bay City, Mich.; cranes in locomotive shop, William Sellers & Co., Philadelphia; steam pipe covering, the Keasbey & Mattison Company, Ambler, Pa.; boilers, Edward Kendall, Boston; engines, the Westinghouse, the Fitchburg Steam Engine Companies, and Messrs. Armington & Sims.

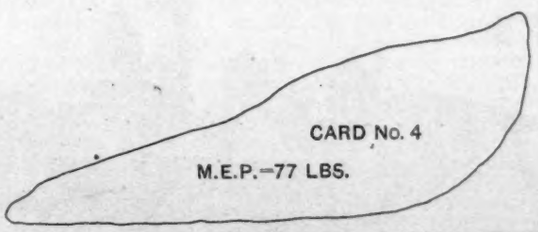
Mr. C. H. Wiggin, master mechanic, is in charge of the locomotive department, and Mr. J. T. Gordon of the car department.

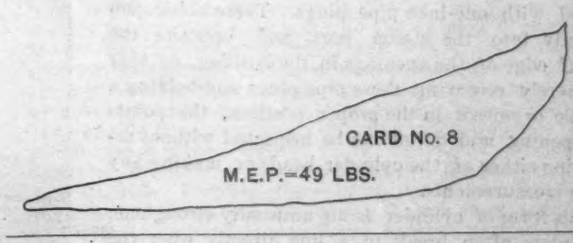
LOCOMOTIVE WITH PISTON VALVES—NORFOLK & WESTERN RAILWAY.

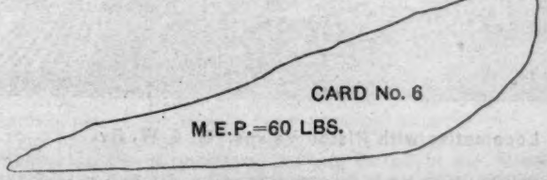
It has been quite common for simple or single expansion engines to be changed into compounds to the improvement of the engines, and it is not common to see compounds changed into single expansion engines with good results; but Mr. G. R. Henderson, Mechanical Engineer of the Norfolk & Western Railway, has kindly furnished us with very interesting information concerning such a change on a locomotive on that road which has been attended with very interesting and valuable results, which tend to confirm three opinions, viz.: That simple engines may be vastly improved without resorting to any questionable practices or any complications; that compound engines may probably be improved in proportion by very nearly the same process, and that a piston valve is "a good thing."

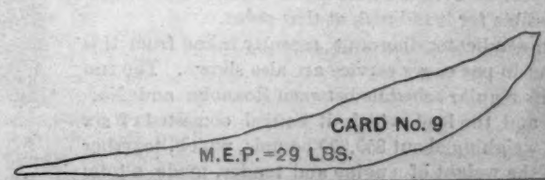
The engine was originally built as a compound, but, partly for experimental purposes, it was decided to replace broken cylinders with simple cylinders, fitted with piston valves. The general features of the engine in its present condition are as follows:











Card No. 4.—Boiler pressure 172 pounds; throttle $\frac{5}{6}$; cut-off, 7 inches; speed, 35 miles per hour.
Card No. 6.—Boiler pressure, 178 pounds; throttle full; cut-off, 8 inches; speed, 56 miles per hour.
Card No. 8.—Boiler pressure, 175 pounds; throttle full; cut-off, 8 inches; speed, 68 miles per hour.
Card No. 9.—Boiler pressure, 135 pounds; throttle, ¼; cut-off, 5 inches; speed, 73 miles per hour.

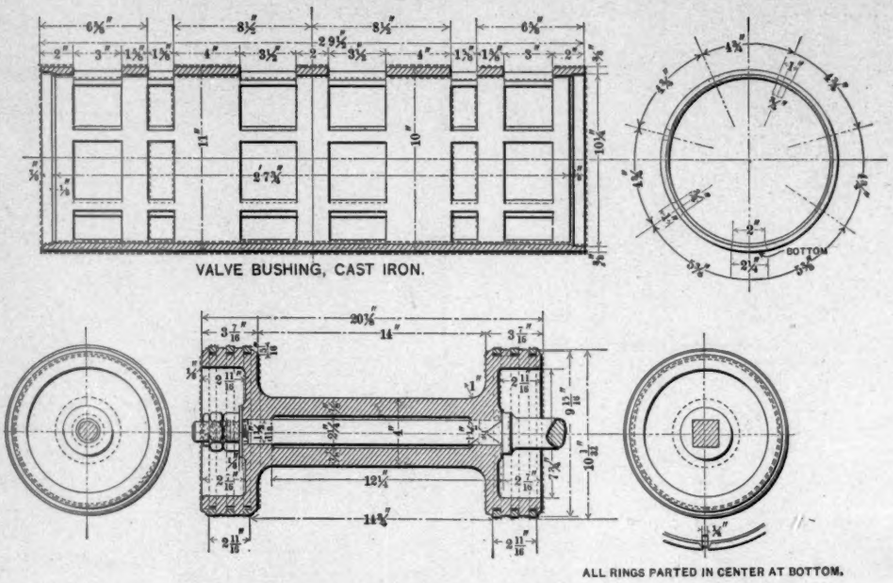
Locomotive with Piston Valves—Norfolk & Western Railway.

Type of engine	10 wheel
Diameter of cylinders	20 inches
Stroke of cylinders	24 inches
Diameter of driving wheels	68 inches
Boiler pressure	180 pounds
Grate area	29 square feet
Heating surface	1,967 square feet
Adhesive weight	102,300 pounds
Total weight of engine and tender	220,200 pounds

The general appearance of engine and tender is shown by the photograph, and the appearance of the cylinders with piston valves is neat and attractive.

Some features of the detail design of the cylinders and valves may be specially mentioned. The drawings show that the piston valve is located nearly on a straight line drawn from the center of the cylinder to the center of the steam pipe connection, and the section *D D* shows that the ports from the valve to the cylinder are very short and direct; the steam enters the saddle and passes in a straight line to the center of the valve chamber, from which it is distributed on each side by the valve, the exhaust ports being on the outside edge of the cylinder at the front and back. In this way the steam passages are well protected and surrounded on the front and back ends by the exhaust passages, which make a sort of steam-jacket, and the ribs on the outer surface support a lagging, which further protects the steam passage from direct radiation. Another advantage of this arrangement is that the valve-stem stuffing box has practically no pressure upon it, and there should be little trouble in keeping the packing tight.

The valve itself has three packing rings, and, of course, in this case the outside lap is really measured on the inside of the valve, and amounts to 1¼ inches. The valve has $\frac{1}{16}$ inch inside, or really outside, clearance, and in setting no lead was given in full gear.



Sections of Valves and Bushing.

One serious objection to piston valves has been the difficulty which attended setting them properly. With the usual construction of slide valve and steam-chest, it is a very easy matter to get the exact position of the valve relative to the ports by leaving the lid off; but ordinarily with a piston valve the only way these points can be settled is by measurements, carefully taken, from the valve and bushing before they are put in place. To overcome this difficulty two holes will be seen to be provided, marked *H H*, and these are closed with one-inch pipe plugs. These holes open directly into the steam port, and opposite the cutoff edge of the openings in the bushing, so that by merely removing these pipe plugs and holding a candle or mirror in the proper position, the points of opening and cutoff can be inspected without removing either of the cylinder heads or making any close measurements.

This form of cylinder is an unusually strong one. Cylinders often break in a line directly over the front end of the frames, but from the shape which this form of cylinder assumes it would seem almost impossible for it to break at that point.

Some indicator diagrams recently taken from this engine in passenger service are also shown. The run was its regular schedule between Roanoke and Norfolk, and the load which it hauled consisted of six cars, weighing about 350,000 pounds, which, together with the weight of engine and tender, made a total of 285 tons. Card No. 1 was taken on a 66-foot grade, as the engine was accelerating the train from a stop. Card No. 4 was taken as the train was being hauled up a 61-foot grade at a speed of 35 miles per hour. Card No. 9 was taken running on a slight down grade. Other cards not reproduced were taken on portions of road which were practically level, or on which the grades were slight or short. We think it is interesting to note the full outline of the cards, which is due, undoubtedly, to the piston valve, which gives a very large opening for the admission of steam, and also to the fact that the back pressure is very fair, and the compression about what would be desired. The cards at high speed seem to be exceptionally able bodied. They are indeed "fat and jolly." In two cases the indicated horse power exceeded 1,100.

During the month of October, 1897, this engine (No. 77) had the same run as one of the compound engines (No. 75) from which type it had been converted, and a comparison has been made of the performance during this time. Both engines were hauling trains No. 3 and 4, between Norfolk and Roanoke, during this period. The record shows as follows:

Eng.	No. pass. car mls.	Mls. light.	Coal in lbs.	Lbs. coal per car ml.
75 (comp.)	35,219	115	364,000	10.24
77 (simple)	35,430	100	367,500	10.28

From the above, it will be seen that engine 77 used about four-tenths of one per cent. more coal than engine 75 in identically the same service, and this small amount could easily be accounted for by variations in quality of fuel, or other minor causes. As compound engines usually show an economy of from 15 to 20 per cent. in fuel over simple engines, we think that this is a very good showing for a simple engine, and that a large

Locomotive with Piston Valves.—N. & W. Rv.

portion of it is probably brought about by the directness of the steam passages, the small amount of clearance and the fact that the steam ports and passages are so well protected against external radiation.

TERMS OF STEAM ENGINE EFFICIENCY.

A committee of the British Institution of Civil Engineers, appointed a year ago or more, says "Science," have reported the following recommendations on steam engine efficiency, and they have been adopted by the Council:

(1) That the statement of the economy of a steam-engine in terms of pounds of feed water per indicated horse power per hour is undesirable.

(2) That for all purposes except those of a scientific nature it is desirable to state the economy of a steam-engine in terms of the thermal units required per indicated horse power (or per minute), and that if possible the thermal units required per brake horse power should also be given.

(3) That for scientific purposes the thermal units that would be required by a perfect steam-engine working under the same conditions as the actual engine should also be stated.

The proposed method of statement is applicable to engines using superheated steam as well as to those using saturated steam, and the objection to the use of pounds of feed water, which contain more or less thermal units according to conditions, is obviated, while there is no more practical difficulty in obtaining the thermal units per indicated horse power per hour than there is in arriving at the pounds of feed water.

For scientific purposes the difference in the thermal units per indicated horse power required by the perfect steam-engine and by the actual engine shows the loss due to imperfections in the actual engine.

A further great advantage of the proposal is that the ambiguous term "efficiency" is not required.

AN ENGLISH OPINION ON AMERICAN FAST TRAINS AND LOCOMOTIVES.

In a recent communication to "The Engineer" of London, Mr. W. M. Ackworth expressed his opinion of American trains and locomotives in part, as follows:

"Having lately returned from a visit to the United States, during which I traveled upward of 1,000 miles on the engines of their crack expresses, I should like to say a few words on the question of American railway speeds. * * * First, as to the 'Atlantic City Flyer.' You state categorically that you believe the record you have published to be fallacious. Now I am quite aware that American railway men have, in some instances, allowed records to go out, apparently with their endorsement, which yet could not stand investigation; but I have no doubt whatever that the Atlantic City performances have, as a whole, been accurately reported, though doubtless the accuracy of the intermediate times is not exactly what we might have looked for. For not only have the Philadelphia & Reading officials and the Baldwin Locomotive Company made themselves responsible for them, and this, not for one month's running only, but for two months; but further, Mr. Voorhees, first vice-president of the Reading, has publicly complimented the 'engineer' of the train on his record performance. Now, considering that probably at least 10,000 passengers, first and last, traveled by the train, and that its origin was due to a disagreement with the competing Pennsylvania Railroad, is it reasonable to suppose that the record, if inaccurate, would have remained entirely unchallenged, as to the best of my belief it has, in fact, done? Further, the same company has been running for some time past, and is still running, a train booked to cover the 55½ miles in 55 minutes, and this train is not only heavier, but uses ordinary instead of picked coal. And that this train, the 4 p. m., ex Philadelphia, keeps time with consummate ease I can testify from personal experience.

"For, having gone to Philadelphia on September 9, in order to travel on the 'Flyer,' and having found to my disappointment that it had ceased to run two or three days previously, I went down on the date mentioned by the 4 p. m. Here are the times taken by me with a split-second stop-watch for every mile from start to stop. I may say that, for convenience of record, I wrote down the nearest whole second, though my watch registered fifths of seconds. But the total time, from the moment the wheels began to turn till they ceased to move, is absolutely exact. Further, in some cases, owing to passing trains or some other accidental causes, I missed a post, and in those cases I have bracketed that mile and the next together:

Miles.	Seconds.	Miles.	Seconds.	Miles.	Seconds.
1	175	20	49	39	50
2	92	21	51	40	51
3	71	22	50	41	52
4	64	23	53	42	51
5	65	24	50	43	54
6 }	119	25	53	44 }	105
7 }		26	53	45 }	
8	57	27	53	46	51
9	53	28	51	47	51
10 }	105	29	48	48	52
11 }		30	48	49	52
12	50	31	50	50	53
13	52	32	49	51	50
14	54	33	48	52	48
15	60	34	51	53	50
16	59	35	51	54	53
17 }	115	36	50	55 }	204
18 }		37	50	stop }	
19	52	38	48		

Total time, 3,210 seconds = 53½ minutes for 55½ miles.

"It will be seen that from the fifth to the fifty-fourth mile posts the speed only varied between 60 and 75 miles an hour. It will be noted also that the last dozen miles or so, which are slightly down hill, are slower than the middle of the run—proof sufficient surely that the engine was running within herself, at least when coupled with the fact that we were on arrival two minutes in front of time. * * *

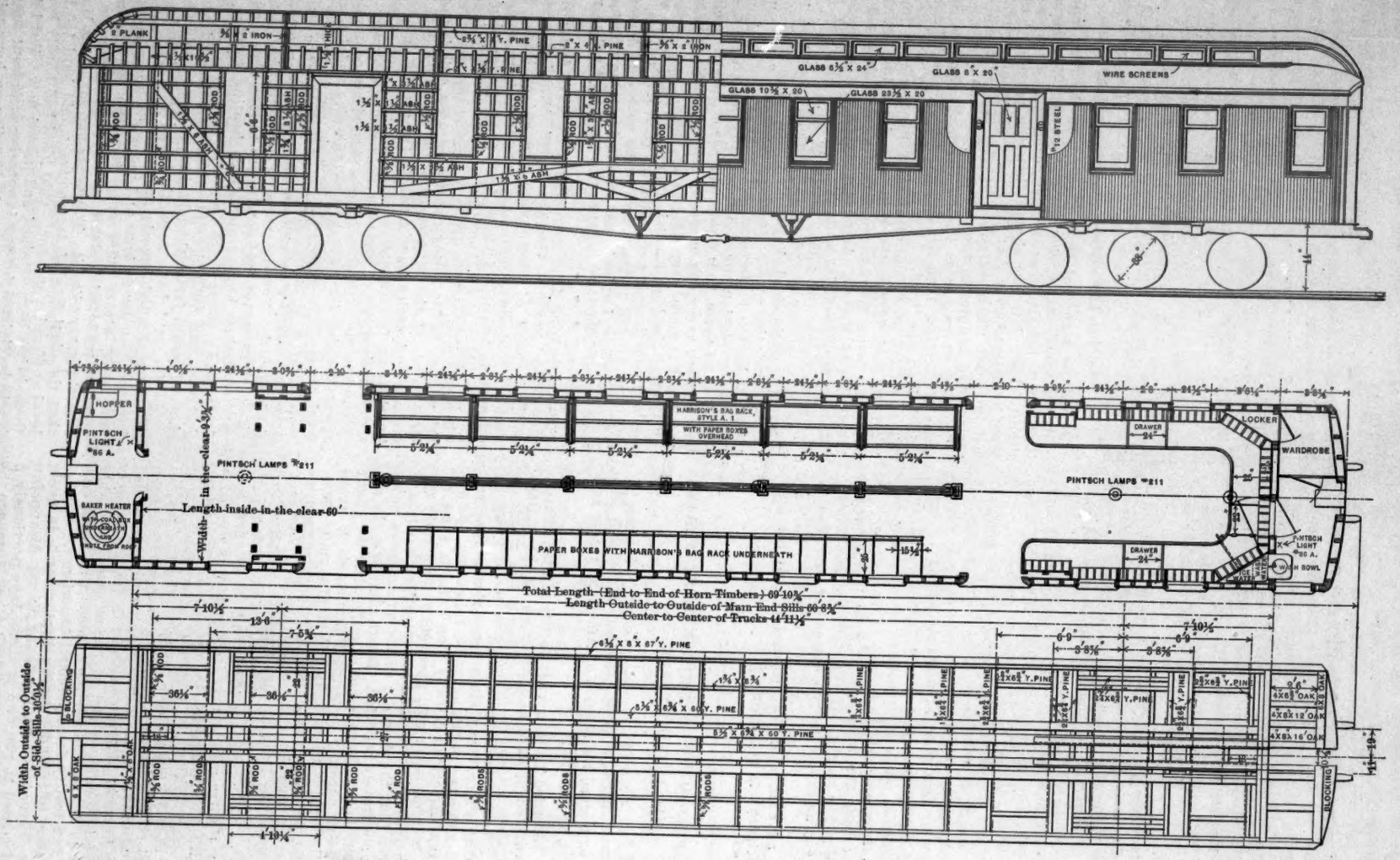
"A week or two later I traveled on the Empire State Express of the New York Central. The load was 178 tons—English—behind the tender. From Syracuse to Rochester, 80½ miles, we ran in 80 minutes; from Rochester to Buffalo, 68 miles, we took 72 minutes, spite of a dead slow over a bridge that was being slewed, and 3 miles at half-speed through the streets of Buffalo. Here is a record of the seconds taken for 18 consecutive miles with this train—51, 49, 48, 48, 47, 46, 46, 47, 47, 46, 46, 92—two miles—46, 46, 48, 45, 47.

"Here is another record, this time from the 'Black Diamond' Express of the Lehigh Valley Company. Load 165 tons—English—behind the tender; Geneva to Sayre, 73½ miles in 74 minutes; Easton to Jersey City, 76 miles, in 79 minutes, with two regular station stops at South Plainfield and Newark, included. And these, be it observed, are not special racing trains, but ordinary every-day expresses which run all the year round, and, what is more, keep time like a clock.

"Whether the best English expresses ought to be as fast as the best American is a question we need not discuss. That, in fact, they are not as fast seems to me proved to demonstration. It is, therefore, I submit, not reasonable to say that American records are fallacious, because there are no English records to match them. * * *

"But, assuming American engines to make faster times than ours, 'Why,' you ask, 'do they do it?' May I suggest, from a layman's point of view, some portion, at least, of the answer? That the American locomotive is in some respects superior as a vehicle I know, from the very practical test that it is possible, on an American engine, to write legible notes when traveling at 70 miles an hour and upward. On an English engine, so far as my experience goes, this is not possible. How much of the difference is due to the higher centre of gravity in America, how much to the greater flexibility given by the bar frames and equallizing levers, or, again, to the superior elasticity of their chairless permanent way, I will not attempt to say. 'Qua' motor, the American locomotive has the advantage that its much greater adhesive weight and tractive force enable it to accelerate its train much quicker. In other words, for a given weight to be hauled at a given speed, American practice provides a much greater reserve of power than English. Further, there is no doubt that American engines, extravagant fuel consumers though they doubtless are, can, with their huge grates, large heating surface and sharp draft, make steam more freely than ours. This must mean that they can fill and empty their cylinders without running short of steam faster than English engines could do.

"As far as I have seen, the maximum American and the maximum English speeds are very much the same. But in England 75 miles an hour and upward implies running down a bank, with steam quite or all but shut off; in America that speed is made with steam on—in other words, on a level or something very like it. Ten years ago Mr. Rous-Marten wrote that the ideal English locomotive would haul 150 tons on the level at 60 miles an hour. That ideal had hardly been attained then—it has been attained and passed now. But I do not think it will be claimed for any locomotive at present running in this country that it can maintain 70 miles an hour with 200 tons behind it on a dead level, and there are, I believe, a good many different types of engines which can do this in the States."


2 PLANK
GLASS 8⅜ X 24
GLASS 8 X 20
WIRE SCREENS
GLASS 10⅝ X 20
GLASS 23⅜ X 20
HOPPER
PINTSCH LIGHT
PINTSCH LAMPS
HARRISON'S BAG RACK, STYLE A. 1
WITH PAPER BOXES OVERHEAD
LOCKER
WARDROBE
DRAWER
BAKER HEATER
Length inside in the clear 60'
Width in the clear
PAPER BOXES WITH HARRISON'S BAG RACK UNDERNEATH
Total Length (End to End of Horn Timbers) 69'10⅜"
Length Outside to Outside of Main End Sills 60'8⅜"
Center to Center of Trucks 44'11½"
Width Outside to Outside of Side Sills 10'0½"
6½" X 8" X 67' Y. PINE
5⅜" X 6¾" X 60' Y. PINE
BLOCKING
4X8X12' OAK
4X8X16' OAK

NEW POSTAL CARS—CHICAGO & ALTON RAILROAD

MR. H. MONKHOUSE, *Superintendent of Machinery.*

PULLMAN PALACE CAR COMPANY, *Builders.*

NEW POSTAL CARS, CHICAGO & ALTON RAILROAD.

The annual reports of the General Superintendent of the Railway Mail Service show that marked and effective improvements have been made during the past few years, as regards the safety and convenience of postal cars, with the general features of which our readers are familiar. The location of postal cars at the head of trains renders them specially liable to damage in case of wrecks, against which all possible precautions are taken to render them safe as well as comfortable for the employees of the department. Pintsch gas equipment is regarded by the department as being not only the best system as regards illumination, but also for the safety of the clerks and the mails in case of accidents. In new cars of this type, Pintsch gas, steam heat, vestibules and other safety appliances are considered necessary and in the design under consideration these features are included.

Two of these cars have been built by the Pullman Palace Car Company, for use on the Chicago & Alton Railroad. They are run over this road from Chicago to St. Louis and are now in service. Through the courtesy of Mr. Lewis L. Troy, Superintendent of the Railway Mail Service at Chicago, we have received the drawings and specifications of these cars. The length, inside in the clear is 60 feet, the length over all, including the horn timbers, is 69 feet 10¾ inches. The length over the main end sills is 60 feet 8¾ inches and the length from center to center of trucks is 44 feet 11½ inches. The width of the car in the clear inside is 9 feet 3¾ inches, the width over side sills is 10 feet ½ inch and the height of the car from the under face of sill to top of plate is 7 feet 4 inches.

The drawings show a half side elevation and half longitudinal section of the framing, a sectional plan view and a plan of the underframe. From an examination of these drawings it will be seen that the car has no platforms, but closed vestibules are provided at each end. At the right hand end, the wardrobe, lockers and washbowl are placed, while at the opposite end are the toilet room and Baker heater. Both of the vestibules, as well as the body of the car, are lighted with Pintsch lamps, of which there are seven, five cluster center lamps and two drop bracket lamps. Each car carries three gas holders, fitted with the necessary attachments, as furnished by the Safety Car Heating & Lighting Company. The Baker heater, enclosed in a zinc-sheathed stove room, has a two-inch coil with four pipes covered with cast-iron fenders running around the car. The coal box is underneath the heater and is extended back of the heater by a chute to the roof.

There are six longitudinal sills of yellow pine, of which the two side sills are 6½ by 8 inches by 67 feet in length, extending to the 6 by 8 inch vestibule end sills. The other sills are placed close together and are 5½ by 6¾ inches by 60 feet, ending at the vestibules. The drawings clearly indicate other features of the underframe. The cars are provided with Blackstone horn timbers, which are 4 by 8 inches by 12 feet of oak, and, like the bumper arms, are plated with ½ by 6 inch iron and bolted every 8 inches with ½-inch carriage bolts. The arrangement of these timbers is clearly indicated in the drawing. There are four needle beams, 4½ by 6½ inches by 10 feet, which are trussed with ¾-inch rods, having struts 12 inches each on side of the center of the car. The flooring is in three courses of yellow pine and the lining under the sills is of ⅞ by 5 inch yellow pine tongued and grooved. There are four side doors, each provided with mail catcher castings. The outside sheathing is of yellow poplar, the ceiling being of the same material matched and beaded. The letter cases, 12 in number and 10 tiers in height, including the necessary drawers and tables, are of ash. Overhead paper boxes are provided, under which are the Harrison racks for mail sacks. The cars have the Westinghouse Air-Brake with quick action triple valve.

The trucks have six wheels each, of the standard 38-inch steel tired Page type, with National Hollow Brake Beams. The axles are of hammered iron, the oil boxes being of the Pullman pattern with Fletcher pressed steel lids. The body springs are double elliptic and coiled springs are placed at the journals, all of the springs being furnished by The A. French Spring Company. The drawings were prepared by Mr. H. Monkhouse, Superintendent of Machinery of the Chicago & Alton Railroad.

CONTINUOUS ROPE DRIVING.

Spencer Miller, member of the American Society of C. E., read before that society on December 15, a paper on the subject "A Problem in Continuous Rope Driving," in which he takes up and reviews the method at present employed in driving with manilla rope, where the driving wheel is larger than the driven, which is usually the case in driving from an engine to a jack shaft, or to a dynamo.

He first called attention to the fact that for efficiency in rope driving, it is necessary to use angular grooves for the rope to rest in, and takes 45 degrees as the best angle employed for such work. The friction in a rope over a pulley is multiplied two and one-half times by the use of this angle, assuming the low coefficient of friction of .12 the coefficient of resistance to slipping becomes .31 by the use of the 45-degree angle. He next demonstrates the value of the large arc of contact of the rope to the pulley, in order to get considerable driving force. When, however, the rope drive is as is usually installed, the larger wheel has very much the larger arc of contact, and the smaller wheel a very much smaller arc of contact.

In consequence of this the larger wheel has a much greater grip on the rope, and a great deal greater driving power. He shows, therefore, that nothing would be lost by widening the angle on the large pulley so that the resistance to slipping is equal in both wheels, and then goes on to demonstrate that not only is there no power lost, but that there is considerable gain in power. He cites an example of a rope drive which was a failure, and explains why it failed. The drive in question had a driver about three times the diameter of the driven, and the centers were quite short, so that the rope on the large pulley was in contact for only 143 degrees. Now with both of these wheels grooved to 45 degrees, and assuming that the rope should not be pulled in any point to a greater extent than 300 pounds, he shows that only about 53 H. P. can be obtained from the transmission, the tight ropes pulling at the rate of 300, 200, 133, 88 and 60 pounds, while by widening the angle of the large sheave to 72 degrees, leaving the small one 45 degrees, each rope gives a pull equal to 300 pounds, and the total power transmitted is 100, which is practically double. This claim might seem paradoxical, but it was nevertheless clearly demonstrated.

Mr. Miller then shows the advantage of using such a method of driving, by referring to a practical example of a drive which he designed some ten years ago, which has been running successfully, transmitting power in a planing mill. This drive transmitted 250 h. p., and was designed so as to use a 1¼ or 1⅛-inch rope, but in order to demonstrate the life of the rope, and the effect of the sudden tension of the load, he put on a ⅞-inch common manilla rope, bought from a ship chandler, and this first rope lasted six years before it had to be replaced. Since that time, of course, larger rope has been used.

The paper gave a full scientific analysis of the strains on the rope from a theoretical standpoint, which agreed perfectly with the practical effect as shown in the transmissions of this character all over the country.

The compound winder which has been used for dynamo driving was shown to have defects in that the various strands of the rope do not pull alike, and while the compound winder has the advantage of being a safe method of transmitting power, he nevertheless proves that the compound winder would not be necessary at all, if his method of widening the angle of the large pulley was employed, reducing the friction on the large pulley equal to that of the small pulley. He also showed the disadvantage of using an angle of 60 degrees in place of 45, as it increased enormously, in some cases as high as 43 per cent., the journal friction engendered by the extra tension on the ropes required to transmit the requisite power. The theory of the paper was proved to be correct in many

ways, among others by the way in which the wooden sheaves, which were introduced in the early history of rope driving, wore on their grooves.

The paper was discussed by Prof. J. J. Flather, whose book on rope driving is without question the best text book ever written on the subject, by Samuel Webber, a leading authority on power transmission, by J. H. Hoadley, who has designed a large number of heavy rope drives, by H. W. Brinckerhoff and H. H. Supplee, all engineers associated with the subject, and all of them practically endorsed the theory advanced in the paper.

The use of the wider angle in the larger pulley was patented by Mr. Miller in 1891. Mr. Miller is the engineer in charge of the cableway department of the Lidgerwood Manufacturing Company, 96 Liberty street, New York City.

COMPOUND LOCOMOTIVES.*

By Prof. J. B. Johnson.

With reference to the future of the compound locomotive, my opinion is the compound locomotive has come to stay. It is peculiarly adapted to American conditions. With heavy loads at moderate speeds, it certainly does save from 15 to 20 per cent. of the fuel cost, as now built and operated, and this is a considerable item. On light train or on high speed service there is little saving of fuel, but where heavy passenger trains are to be hauled at the highest speeds, or when the speed is limited by the steaming capacity of the boiler, there is a considerable reduction in the water to be evaporated, and hence less difficulty in maintaining the pressure. While the cylinder repairs are increased, or perhaps doubled, the boiler repairs are greatly reduced, thus reducing the total expense, because the boiler repairs are the main item. Where the water is bad a reduction of the evaporation by 20 per cent. means a reduction of the incrustation by more than 20 per cent., because the incrustation rapidly increases as the impurities accumulate by concentration at the end of the run. The compound locomotive has been largely abandoned in England because the loads are small and their speeds high; but wherever the work of the engine is very heavy and the speeds moderate, the compound locomotive is winning its way on its merits the world over. One American manufacturer has turned out over 800 of these improved locomotives, all since 1890, and now at the rate of 200 a year, and all large American railway systems which have heavy work and have given them a fair trial are rapidly approaching their exclusive use in this class of service. The inertia, not to say prejudice, of the average locomotive engineer is largely responsible for the slow adoption of this new improvement, but our master mechanics and superintendents of motive power are, I suspect, not altogether blameless. We hesitate to venture into new and unfamiliar fields when we know we are to be held responsible for results. While a judicious conservatism is both laudable and even necessary in railroad management, I believe any further hesitation to acknowledge the merits of the compound locomotive in the class of traffic named above is a blind shutting of the eyes to demonstrated facts, which will soon be regarded as a sure mark of inefficiency in this department of railroad management.

I have had sent to me a sheet showing the saving in fuel on two divisions of the Chicago, Milwaukee and St. Paul Railway, as compared between their simple engines and compound engines of the same class, and they have a great many of each class.

This is a statement covering the entire year on two divisions of the road, the record simply showing the saving in coal, which is something of which a record can be kept, and apparently they have been doing equal work. The saving in coal is given per ton mile, and then the per cent. of saving, the average saving for one year; on the East La Crosse Division, 18.3; on the West La Crosse Division, 20.8 per cent. These figures, I think, speak louder than any man's opinion.

* From remarks made before the St. Louis Railway Club.

MR. YARROW ON AMERICAN MACHINERY.

Mr. A. F. Yarrow, the celebrated English marine engineer, who has been in this country for some time, is evidently impressed by the progress of American machinery builders and iron workers. According to an interview recently published in the New York "Sun" he said:

"American iron and steel workers are better paid than English, but they do far more than proportionately better work. They have superior diligence, application, and ingenuity, and take more interest in their work. It seems to be the rule for each man to do as much work as he can, while at home every one is afraid of injuring his fellow workman, and does no more than he has to. One noticeable thing in connection with this is the tending of automatic machines. I have seen one man in charge of several machines here, while at home it's against the rules of the union for a man to tend more than one. Consequently he is idle a considerable part of the time. When a new machine is introduced into an English shop, the union decides the rating of a man to tend it, instead of allowing a man who is doing similar work to take charge of the new tool.

"The lowered prices of raw material in this country have put American engineers into direct competition with their English contemporaries, and I believe this competition will continue and grow keener. The materials, etc., for the Central Railway in London are being supplied by Americans, who are also shipping steel billets to England, boiler plates to Holland, and deck beams to Belgium. These are all centers of the various industries using those materials, and England formerly supplied them. I foresee that America will soon take the first place in the world unless England bestirs herself and

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

Comparative Coal Statement for Compound and Simple Engines, East and West La Crosse Division, for 12 Months Ending June 27, 1897.

	East La Crosse Division.					West La Crosse Division.			
Months.	Style of engines.	Pounds of coal per 100 tons hauled one mile.	Cost per ton per mile.	Per cent. saved by compound engine.	Amount saved had all engines been compound.	Pounds of coal per 100 tons hauled one mile.	Cost per ton per mile.	Per cent. saved by compound engine.	Amount saved had all engines been compound.
July, 1896	Compound	11.02	.000935	18.5	$548.21	10.18	.000865	16.1	$438.11
	Simple	13.52	.001150			12.14	.001032		
August, 1896	Compound	11.57	.000983	22.0	672.98	10.37	.000882	18.2	508.64
	Simple	14.12	.001201			12.26	.001042		
September, 1896	Compound	11.90	.000982	19.7	656.45	10.99	.000907	20.6	569.97
	Simple	14.25	.001117			13.24	.001092		
October, 1896	Compound	10.20	.000867	15.3	491.89	10.57	.000897	23.9	836.22
	Simple	11.76	.001000			13.10	.001114		
November, 1896	Compound	13.82	.001141	20.6	909.34	12.28	.001013	20.8	821.26
	Simple	16.68	.001376			14.83	.001224		
December, 1896	Compound	14.04	.001193	23.5	982.38	12.92	.001077	21.1	716.30
	Simple	17.33	.001473			15.34	.001304		
January, 1897	Compound	15.40	.001308	18 5	447.52	13.32	.001133	16.7	517.42
	Simple	18.25	.001551			15.54	.001321		
February, 1897	Compound	14.45	.001229	19.0	6-0.17	12.99	.001104	18.0	597.30
	Simple	17.19	.001461			15.32	.001302		
March, 1897	Compound	14.01	.001155	16.0	488.50	12.17	.001004	28.0	725.87
	Simple	16.24	.001340			15.54	.001282		
April, 1897	Compound	12.41	.001055	16.0	478.12	11.63	.000989	15.0	402.53
	Simple	14.36	.001221			13.34	.001134		
May, 1897	Compound	11.58	.000984	18.0	500.78	10.90	.000927	20.0	514.61
	Simple	13.62	.001158			13.06	.001110		
June, 1897	Compound	10.93	.000002	20.0	493.84	9.94	.000820	26.0	668.17
	Simple	13 09	.001880			12.55	.001035		
Average,	Compound	12.65	.001064	18.3		11.50	.000968	20.8	
	Simple,	14.97	.001260			13.89	.001168		
Total					$7,353.18	Total			$7,316.40

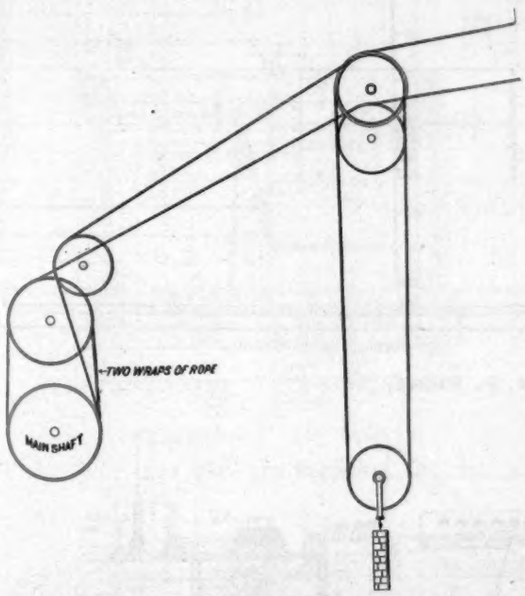
shakes off the attitude of indifference assumed thirty years ago, when she was at the head in engineering industries.

"During my visit here I have purchased a quantity of small machine tools which are superior to the English makes. With such tools the price is of small moment; the best is wanted, no matter what the cost, though prices here compare favorably with those at home."

A ROPE DRIVE IN A RAILROAD SHOP.

The distribution of power from a central point in order to avoid the expense of operating independent stationary boilers and engines is now engaging the attention of many mechanical engineers, and there is probably no more favorable field for operations of this kind than in railroad shops, where it is not unusual to find a comparatively large number of isolated steam boilers and engines operating in the various departments. There are several methods of power distribution possessing advantages according to the special conditions of location and operation, one of which, a rope drive was selected in the case under consideration.

Formerly the power used in the boiler shop of the Waukesha shops of the Wisconsin Central was furnished by a Westinghouse engine and an independent boiler, and as the main engine in the locomotive shop had a reserve power not needed for that shop it was decided to connect it with the main shaft of the boiler shop by a rope drive, for which the location was favorable, and this permitted of doing away with the boiler shop steam plant. The main shafts in the two shops are parallel and about 200 feet apart horizontally, running in oposite directions. In order to carry the rope to the boiler shop it was necessary to lead from the main shaft in the machine shop up and over the locomotive traveling cranes and through the roof, across the space between the buildings to the boiler shop. A system of idlers carries the rope down into the boiler shop, and by crossing the lines the right direction of motion of the driven shaft is obtained.



Rope Drive and Tension Attachment—Waukesha Shops, Wisconsin Central Lines.

Two wraps are used on the boiler shop sheave and a single wrap was sufficient on that of the main shop on account of the large diameter of the driving sheave. A single strand of special 1-inch manilla rope is used, the power transmitted being about 35 horse-power. The tension carriage is in the boiler shop, and is of the vertical type, providing automatic adjustment of the tension on the rope taking up the slack. This is placed in the boiler shop where it is under cover. The system is reported to be working satisfactorily, and the saving in the cost of operating the boiler shop is considered as warranting the change.

The engraving illustrates the boiler shop end of the drive, and was prepared from a photograph received through the courtesy of Mr. James McNaughton, superintendent of motive power of the road.

DANGERS IN ANNEALING.*

F. A. Pratt, President The Pratt & Whitney Co.

We have most of our tap steel annealed at the place where it is made. We have had it done in this way for some years, with the exception of our long stay-bolt taps, which we have found to require more care in annealing than the steel-makers give them.

More steel is injured, and sometimes spoiled, by over-annealing than in any other way. Steel heated too hot in annealing will shrink badly when being hardened; besides, it takes the life out of it. It should never be heated above a low cherry-red, and it should be a lower heat than it is when being hardened. It should be heated slowly and given a uniform heat all over and through the piece.

This it is difficult to do in long bars and in an ordinary furnace. The best way to heat a piece of steel, either for annealing or hardening, is in red-hot, pure lead. By this method it is done uniformly and one can see the color all the time. We do some heating for annealing in this way and simply cover up the piece in sawdust, and let it cool there, and we get good results. All steel-makers know the injurious effects of over-heating steel and of over-annealing, but their customers are continually calling for softer steel and more thorough annealing. Until users are educated up to the idea of less annealing and to working harder steel, both will suffer, for the user will continually complain of poor steel.

Several years since we caught on to the fact that steel was injured by over-annealing, and that good screw-threads could not be cut in steel that was too soft; our men would rather take the steel bar direct from the rolls without any annealing than to take the risk of annealing. At present we get it from the makers in passable condition, but not as it should be, and unless the steel-makers find some way to heat the bars of a uniform heat, and at a low cherry red, we must either use it raw from the bar or anneal it ourselves. We find, also, that this soft annealing makes a much greater shrinkage and spoils the lead of the thread, and that from the bar without any annealing there is very little trouble in this respect.

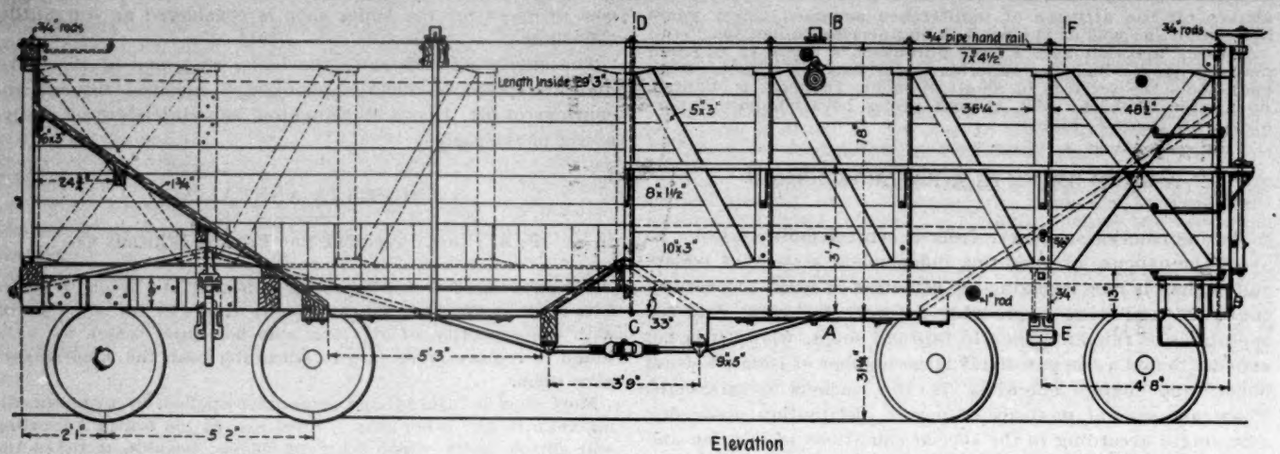
When O. H. and Bessemer machine steel was first introduced, it was poorly made and hard to work. Users constantly urged the makers to make it softer, until when a maker could say his steel was as soft as iron, and not more than .10 or .15 of 1 per cent. carbon, he had the market. This company found out early that this soft machine steel was almost worthless. A shaft would bend easily in working, and if a lead-screw was to be cut it was not possible to get a smooth thread and a good finish.

Now we either make shafts and spindles of cast-steel of a high carbon, or of machine steel of about 50 per cent. carbon, without annealing. Our men kicked at first, but now they complain if it is soft, because they cannot cut a good thread and cannot keep it as true.

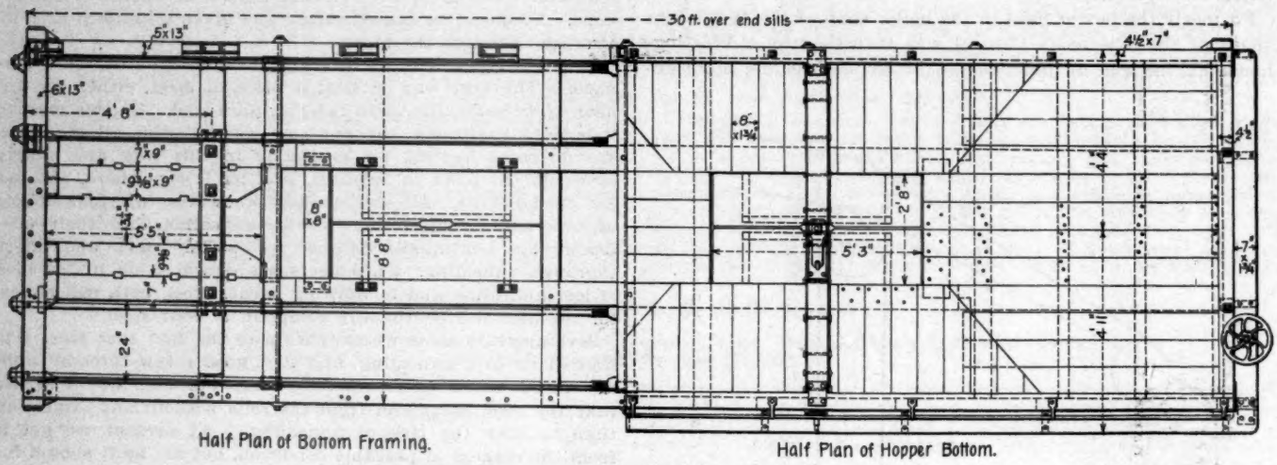
A report of L. L. Buck, chief engineer of the new East River Bridge, between New York City and Brooklyn, just issued shows that good progress is being made in the work upon the structure. The New York pier is now finished to a height of 2.54 feet above high water. The contract for the tower foundations on the Brooklyn side was let on June 30 last, and work begun on July 26. The south caisson was launched on October 19 and the north caisson on December 15. Mr. Buck estimates the cost of the work under way as follows:

New York tower foundations	$370,000
New York anchorage	716,770
Brooklyn tower foundations	507,000
Brooklyn anchorage	721,850
Total	$2,315,620

*Sparks from the Crescent Anvil.

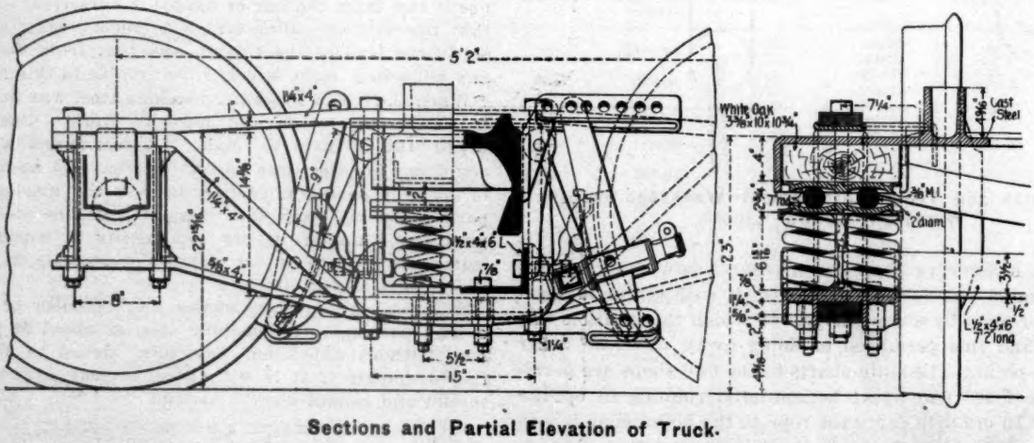


Elevation



Half Plan of Bottom Framing. Half Plan of Hopper Bottom.

70,000-Pound Coal Car—N. P. Railway.



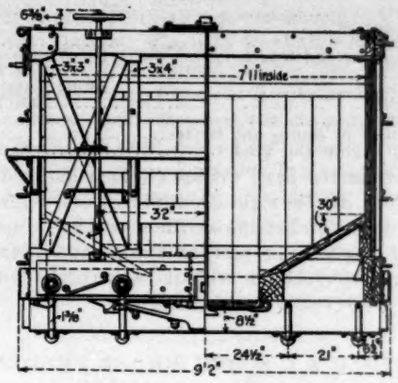
Sections and Partial Elevation of Truck.

70,000-POUND COAL CARS, NORTHERN PACIFIC RAILWAY.

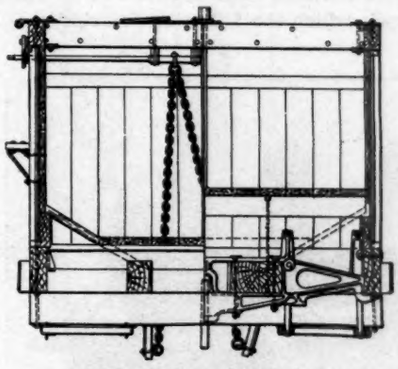
Through the courtesy of Mr. E. M. Herr, Superintendent of Motive Power of the Northern Pacific Railway, we have received drawings of new hopper, gondola coal cars of 70,000 pounds capacity, weighing 28,400 pounds, which while not constituting radical departures in designing are interesting particularly because 1,070 cubic feet of space, when level full, is provided in a car 30 feet long over end sills and 6 feet 6 inches deep from the lower edge of the side sills to the top of the sides; this in a car of the twin hopper type is not usual. The length of the car inside is 29 feet 3 inches, the width over side sills is 8 feet 8 inches and the width inside 7 feet 11 inches. The hopper bottoms are carried down into and below the body of the car as far as possible and at the same time maintain an angle of 33 degrees for the sloping surfaces. This angle is used, except for the sides of the hoppers, which are at an angle of 30 degrees with the horizontal. The height of the bottom of the side sills above the rails is 31¼ inches, the wheels are 33 inches in diameter and the height over the brake wheel is 9 feet 7⅝ inches above the rails. The illustrations show a sectional elevation, a half longitudinal section, a half plan of the car and half plan of the underframing, as well as transverse sections and a half end elevation, which show quite clearly the features of the design.

Attention is called to the 4 longitudinal sills, the side sills being 5 by 13 inches and the center sills 7 by 9 inches in

section. The end sills are 4½ by 7 inches, the needle beams are 5 by 9 inches and intermediate cross timbers, 5 by 9 inches, assist in carrying the hoppers. The door openings are 5 feet 3 inches by 2 feet 8 inches, the drop doors being covered



End View. Half Section A-B



Half Section C-D Half Section E F.

End View and Sections.

bolted to the body bolsters, which are of cast steel and are so made as to admit the center sills and draft timbers, and they extend beyond the bolsters to a 6 by 9-inch timber, which is let into the center sills. Four truss rods are used, having a diameter of 1⅜ inches, so arranged as to lie close to the sills of the car. The ends of these rods are upset to a diameter of 1¾ inches. The sides of the car are tied together vertically by means of ¾-inch rods passing through the top rails and the side sills outside of the siding. The siding is braced by 5 by 3 inch verticals and diagonals, and the siding is composed of 8 by 1½ inch plank, except the lower course which supports the sides of the hoppers and is made of 10 by 3 inch material. The hoppers are of 8 by 1¾ inch material.

The engravings show the method of raising the hoppers and locking them, they also show the 7 by 1¾ inch running board, which extends along the ends and one side of the car for the purpose of furnishing a footing for the men operating the doors. A ¾-inch gas pipe hand rail extends along operating side.

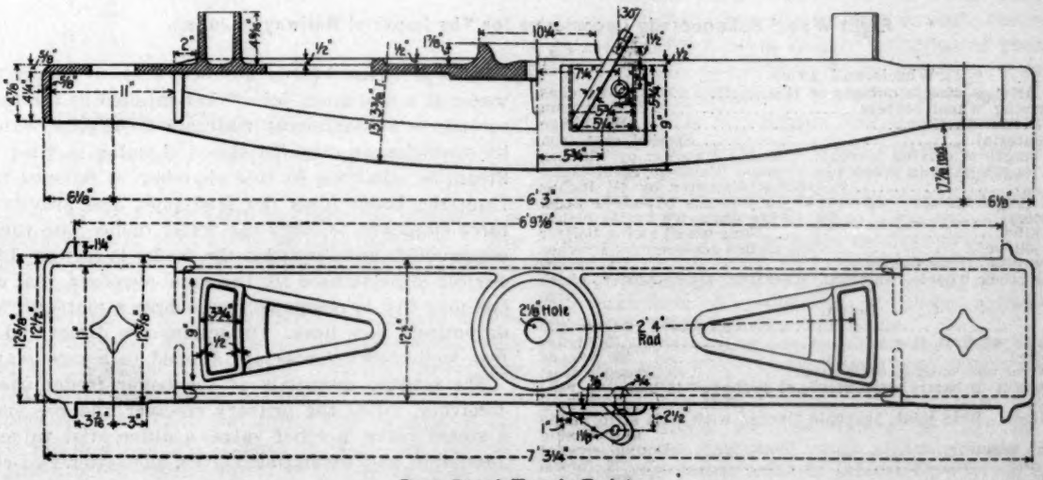
The trucks are of the arch bar type, the truck bolsters being of cast steel, supported upon the springs by roller bearings. The top arch bar has a rise of 1 inch at its center, making the truck a low one. The wheels are of cast iron, 33 inches in diameter, weighing 600 pounds and the axles have 4½ by 8 inch journals with a wheel fit 5⅝ inches in diameter. The drawings of the trucks and of the truck bolster show clearly the manner of constructing these parts, and the roller bearings for the truck bolster. One hundred of these cars have been built at the Tacoma shops of the road, the cast steel body and truck bolsters for which were furnished by the American Steel Foundry Company, of St. Louis, Mo.

BALTIMORE & OHIO PRESIDENTS.

The recent annual meeting of the Baltimore & Ohio Railroad Company, which was its seventy-first, brings to mind the fact that the B. & O. has had ten presidents in 71 years, as follows:

Philip E. Thomas, Louis McLane, Thomas Swan, William G. Harrison, Chauncey Brooks, John W. Barrett, Robert Garrett, Samuel Spencer, Charles F. Mayer and John K. Cowen. The line was put in operation to Harper's Ferry in 1834, was built to Winchester, Va., in 1836, and to Strasburg in 1870. Westward it went to Cumberland in November, 1842, and on to Wheeling, W. Va., by January 1, 1893. The Parkersburg branch from Grafton to Parkersburg was opened May 1, 1857.

It is the only great railroad company that is being operated under its original name and charter.



Cast Steel Truck Bolster.

with No. 10 steel plate. The V-shaped portion of the hoppers, at the center, rests upon the needle beams, which are spaced 3 feet 9 inches apart. Short pieces 8 by 8 inches in section extend across the center sills to support the inner edges of the long slopes of the hoppers at the door openings. The ends of the car under the hoppers are left open. The draft timbers are 9¾ by 9 inches in section and are secured to the inner faces of the center sills. They are 5 feet 5 inches in length, are

EIGHT-WHEEL LOCOMOTIVES FOR JAPAN.

The accompanying engraving and table of dimensions show the chief interesting features of ten eight-wheel narrow gauge locomotives, recently built by the Schenectady Locomotive Works for the Imperial Railways of Japan. The tender is carried on three axles, there is no pilot and the headlight is very small, otherwise the general appearance of the design strongly resembles American practice. A separate dome is provided for safety valves and whistle. The valves are the American Balance type. Other features are noted in the following table:

General Dimensions.

Gage	3 feet 6 inches
Fuel	Japanese bituminous coal
Weight in working order	78,600 pounds
Weight on drivers	52,350 pounds
Wheel base, driving	7 feet

Cylinders.

Diameter of cylinders	16 inches
Stroke of piston	24 inches
Horizontal thickness of piston	5¼ inches
Diameter of piston rod	2½ inches
Kind of piston packing	Cast-iron rings
Kind of piston rod packing	Jerome metallic
Steam ports	14 inches by 1¾ inches
Exhaust ports	14 inches by 2½ inches
Bridges ports	1 inch

Valves.

Kind of slide valves	American balanced
Greatest travel of slide valves	5½ inches
Outside lap of slide valves	⅞ inch
Inside lap of slide valves	Line and line
Lead of valves in full gear	Line and line
Kind of valve stem packing	Jerome metallic

Wheels and Axles.

Diameter of driving wheels outside of tire	54 inches
Material of driving wheel centers	Cast iron
Tire held by	Shrinkage
Driving box material	Steeled cast iron
Diameter and length of driving journals	7 inches diameter by 8 inches
Diameter and length of main crank pin journals (Cambria Steel Coffin process)	4½ inches diameter by 4¼ inches
Diameter and length of side rod crank pin journals (Cambria Steel Coffin process)	3¾ inches diameter by 3½ inches
Engine truck, kind	Four-wheel swing bolster
Engine truck, journal	4½ inches diameter by 8 inches
Diameter of engine truck wheels	26 inches
Kind of engine truck wheels	National, steel-tired spoke center, 3-inch tire

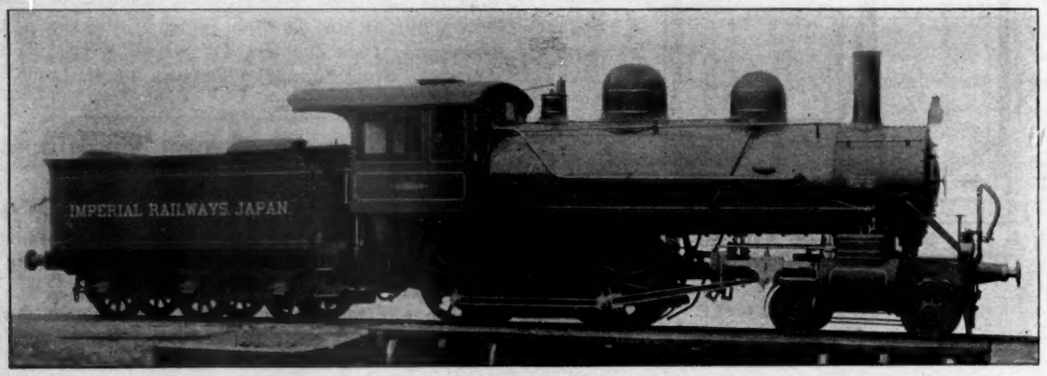
Boiler.

Style	Extended wagon top
Outside diameter of first ring	52 inches
Working pressure	160 pounds
Material of barrel and outside of firebox	Carnegie steel
Thickness of plates in barrel and outside of firebox	9-16 inch., ⅝ inch, 7-16 inch and ½ inch
Horizontal seams	Butt joint, sextuple riveted with welt strip inside and outside
Circumferential seams	Double riveted
Firebox, length	78 inches
Firebox, width	29¾ inches
Firebox, depth	Front, 55 inches; back, 48 inches
Firebox, material	Copper
Firebox, plates, thickness	Sides, ½ inch; back, ½ inch; crown, ½ inch; tube sheet, ⅜ inch to ½ inch below tubes
Firebox, water space	Front, 4 inches; sides 2½ inches; back, 3 inches to 4 inches at crown
Firebox, crown staying	Radial stays, 1 inch diameter
Firebox, stay bolts	15-16 inch soft rolled copper
Tubes, material	Solid drawn brass
Tubes, number of	196
Tubes, diameter	1¾ inches
Tubes, length over tube sheets	11 feet
Heating surface, tubes	980.17 square feet
Heating surface, firebox	93.5 square feet
Heating surface, total	1,073.67 square feet
Grate surface	16.04 square feet
Grate, style	Rocking, with drop plate
Ash pan, style	Sectional, dampers, front only
Exhaust pipes	Single high
Exhaust nozzles	3¾ inches, 4 inches, 4¼ inches diameter
Smokestack, inside diameter	14 inches
Smokestack, top above rail	12 feet 1 inch
Boiler supplied by two Sellers injectors, Class "N" improved of 1887, No. 8½.	

Tender.

Weight, empty	25,750 lbs.
Wheels, number of	6
Wheels, diameter	36 inches
Journals, diameter and length	4½ inches diameter by 8 inches
Wheel base	10 feet 2 inches
Tender frame	Steel plate and channels
Water capacity	2,400 U. S. gallons
Coal capacity	3 tons
Total wheel base of engine and tender	40 feet
Total length, engine and tender	48 feet 10 inches

These locomotives have Coales 2½-inch encased pop safety valves, Detroit double sight feed lubricators, Smith's automatic vacuum brake on driving and tender wheels, spring buffers on front of engine and rear of tender and between engine and tender, Crosby chime whistle, Ashcroft steam gage, and three eight-inch bull's eye headlights.



Eight Wheel Schenectady Locomotive for The Imperial Railway of Japan.

THE Q & C SCOTT BOILER FEEDER.

A new device for forcing feed water into steam boilers, manufactured and sold by the Q & C Company, is shown in the accompanying illustration. A pamphlet received from the manufacturers contains an explanation of its construction and operation upon which the following description is based:

Its objects are two in number; first, to supply boilers with water at a cost much below that entailed by the use of pumps; second, to automatically maintain a constant water level. In its operation an elevated closed chamber is filled with water. Steam is admitted to this chamber to balance the pressure from the boiler upon the feed pipe, and gravity is the sole force employed to carry the water thence into the boilers. In construction and operation the feeder is so very different from devices hitherto used for the same purposes, that at first sight one may fail to recognize how simple a matter it is. It works on entirely new lines. Its actions are direct and natural. A few well-known forces are applied in a new way.

The leading essentials of the boiler feeder consist of two receivers, called the primary receiver and the main receiver, a steam valve, a relief valve, a differential valve and check, admission and regulating valves, the latter two classes being used only when the machine is adapted to automatic regulation of the water level.

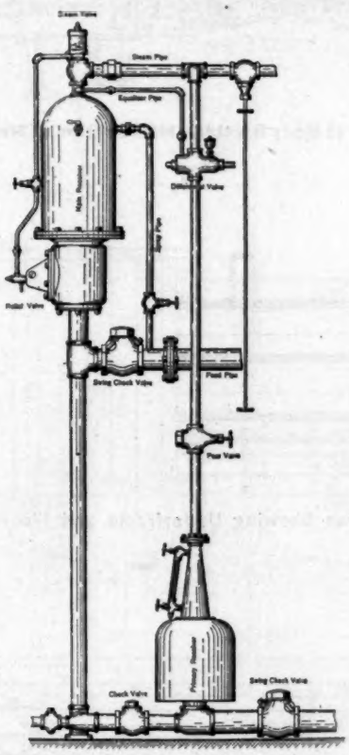
One of these receivers, cylindrical in form, is called the main receiver, and is located in some convenient position and slightly higher than the boilers. The main receiver is surmounted by a steam valve which is opened and closed periodically by the action of a float operated relief valve below the receiver.

The steam valve receives steam at boiler pressure, through a pipe leading directly from the dome or drum, or from some

suitable and convenient steam line. A discharge pipe connects the lower end of this receiver with the main feed pipes leading to the boilers.

The lower or primary receiver is also cylindrical in shape, but is terminated at its upper end by a long cone, to which is attached the steam pipe leading from the differential valve. This receiver is placed in any convenient location on the floor of the engine or boiler room, at a level sufficiently low to insure that it will fill with water from the feed heater, or from the return tank, by gravitation. It is attached to a tee in the connection between the heater and the main receiver, a check valve being placed on each side of the primary receiver. One of these is to prevent the water which has entered the primary receiver from being forced back to the heater. The other is to prevent the water from returning to the primary receiver after it has been driven to the main receiver.

From a point between the boiler and the check valve in the pipe, a small pipe, called the spray pipe, is taken and carried



The Q. & C.-Scott Boiler Feeder.

to a point near the top of the main receiver. At this point it enters the receiver and terminates on the inside in a distributing or spraying nozzle, set to play against a deflecting plate.

Just above the cone of the primary receiver is placed a pass valve, having a movable disc of peculiar construction. This valve is set in the steam line leading from the differential valve to the primary receiver.

A short pipe is taken from the steam line leading to the steam valve and is led to the primary receiver. In this connection is placed a differential valve, so termed because it is operated by differences of pressure existing at suitable intervals between the main and primary receivers. Besides the steam line leading to the differential valve there are two other pipe connections. One of these leads to the upper part of the main receiver and is termed the equalizer pipe, its office being to communicate to the differential valve, the condition of the main receiver as to pressure. The other is called the exhaust pipe and carries to the heater or to the atmosphere the small amount of steam which is exhausted from the primary receiver.

Just below the main receiver, and in the discharge pipe leading therefrom, a fitting is placed consisting of a chamber within which is a float mounted on a lever, operating a relief valve, which communicates by a small pipe with a space below a piston on the stem of the steam valve. The parts are named in the engraving, and with the following explanation the operation of the device may be understood.

When arranged to take hot water from an open heater, water from the heater enters and fills the primary receiver by gravitation, and is then driven to the main receiver by steam pressure admitted to the primary receiver through the differential and pass valves. When the main receiver is in this manner filled, the steam valve at the top rises and admits steam to the surface of the water. The pressure above the water balances the pressure from the boiler upon the check valve in the feed pipe, and the height of the column of water causes it to fall by gravity, discharging into the boiler. During the time when the main receiver is discharging into the boiler, the primary receiver is re-filling, the steam to force the water from this primary receiver being alternately admitted or cut off by the actions of the differential valve.

The motions of this valve are governed by variations of the pressure in the main receiver, communicated by the equalizer pipe, in such a way that while the main receiver contains full boiler pressure the valve is closed, but when pressure in the main receiver is reduced by a few pounds the valve is opened. When the primary receiver has re-filled, it awaits the reduction of pressure in the main receiver, which is needed to open the differential valve.

Now, assuming the primary receiver to be filled with water and the main receiver to be discharging, the latter will contain full boiler pressure and the differential valve will be closed. The main receiver will continue to discharge until the water recedes to such a level as to allow the float of the relief valve device to fall. This closes the steam valve above and confines a volume of steam equal to the capacity of the receiver above the water level. At this natural radiation with its consequent condensation, almost instantly causes a slight reduction of pressure in this receiver below the pressure in the boiler, and this small reduction permits water to be driven back to the main receiver through the spray pipe, which is connected as before described to the boiler feed pipe.

The spray, which this returning water forms by impact against a deflecting plate, falls through the steam and instantly causes a much greater reduction of pressure, amounting generally to thirty or forty pounds and sometimes to a much greater difference. This fall of pressure opens the differential valve and admits live steam to the surface of the water in the primary receiver, and now full pressure in the latter drives the water to the main receiver. As the main receiver fills, its pressure rapidly recovers until it equals that of the boiler. The differential valve then closes, thus allowing the steam in the primary receiver to exhaust and enabling the receiver to re-fill with water, which condenses whatever steam remains, thereby absorbing all the thermal units therein contained. A repetition of these actions makes the operation of the device continuous.

The device is also applicable to closed heaters and it may be used with water taken from a well or cistern. It may also be used for supplying a battery of boilers for each of which automatic regulating devices are applied. The claim most strongly urged for the device is that of economy of operation, as compared with steam pumps. The manufacturers have taken pains to inform themselves as to the comparative cost of operation of this feeder and pumps, and are prepared to give the results of tests. Further information may be obtained from the Q & C Company, of New York and Chicago.

Trolley cars from Brooklyn are now running at regular, but rather long intervals into New York over the Brooklyn Bridge They will soon be making more frequent trips, and the transition of the bridge from an isolated affair to a part of what may be called trunk line service will be complete.

COAL CARS, 80,000 POUNDS CAPACITY—CHICAGO & EASTERN ILLINOIS RAILROAD.

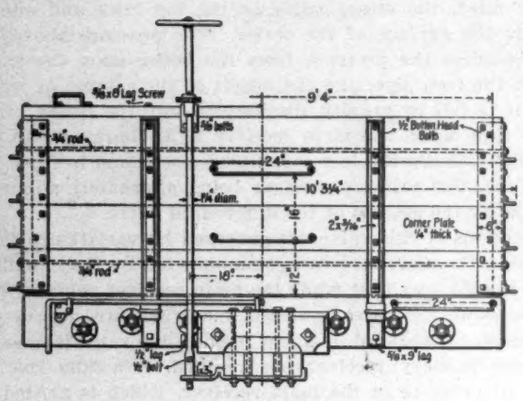
The Chicago & Eastern Illinois has ordered a number of 80,000-pound capacity wooden coal cars from the Haskell & Barker Car Company, to be built to designs and specifications prepared by Mr. T. A. Lawes, superintendent of motive power, to whom we are indebted for the drawings.

The stakes of these cars are arranged inside of the siding, which permits of using a comparatively low side, and widens the body of the car materially. The capacity of these cars, when level full, is 1,176 cubic feet, or 1,050 bushels, and they have carried loads of 83,500 pounds of coal. The length, inside, is 35 feet 7½ inches; the width, inside, is 9 feet 4 inches, and the height of the sides is 3 feet 6½ inches. The length over end sills is 36 feet. The stakes are secured at the bottom by three-quarter-inch bolts and five-eighths-inch carriage bolts.

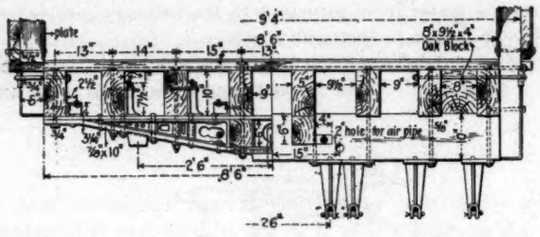
The engravings show the framing and the method of constructing the car and the trucks. There are eight longitudinal sills, 5 by 10 inches in section, all of yellow pine, while the end sills are 9 by 11¾ inches in section. The draft timbers are of 5 by 6 inch oak, and the needle beams are 4 by 10 inches of the same material. Southern yellow pine flooring 1¾ by 6 inches is used, and the siding is 2 by 10½ inches. The car has eight 1⅛-inch truss rods, four of which are carried to a height of 7½ inches above the body bolster, while the other four are 3¼ inches above it, as shown in the sectional view of the floor.

The trucks are of the form designed and patented by the Haskell & Barker Company. The side frames are of the diamond, arch-bar pattern, upon which a built-up bolster is mounted. The bolster has steel plates for its top and bottom members, with peculiar shaped malleable iron filling blocks between. The top plate is ⅞ by 11 inches, and the bottom plate is the same width, but five-eighths of an inch thick. The spring plank is replaced by a 13-inch Carnegie steel channel, and the bolster rests upon the tops of the springs. The body bolster has a straight top plate ¾ by 10 inches, and a bottom plate ⅞ by 10 inches, separated by filling pieces of malleable iron castings, which gives the bolster a depth of 10 inches at the centre.

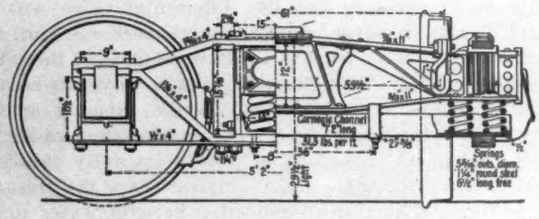
The axles are of steel, with 5 by 9 inch journals. The Westinghouse brake and Tower couplers will be applied.



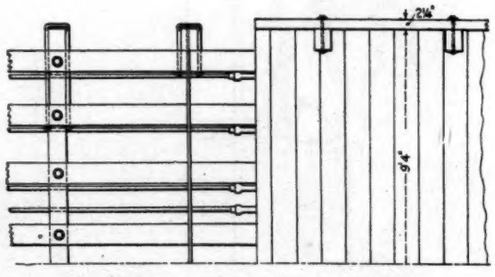
Half End Views.



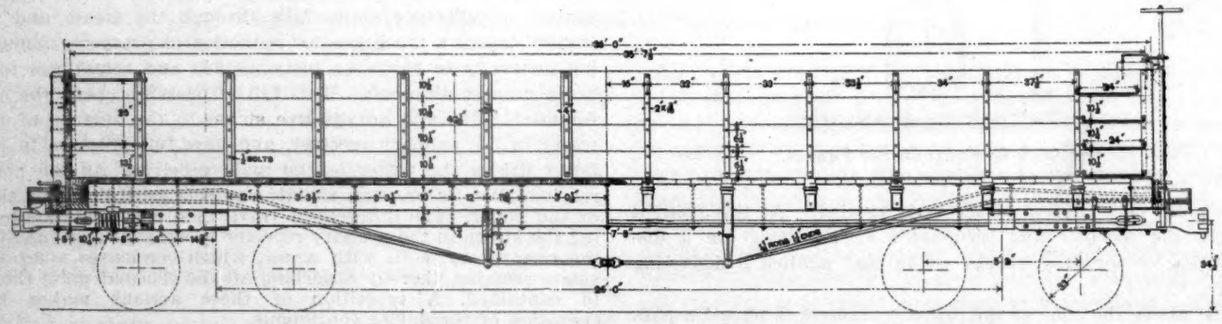
Half Section at Body Bolster. Half Section at Needle Beam.



Metal Truck.



Plan Showing Underframe and Floor.



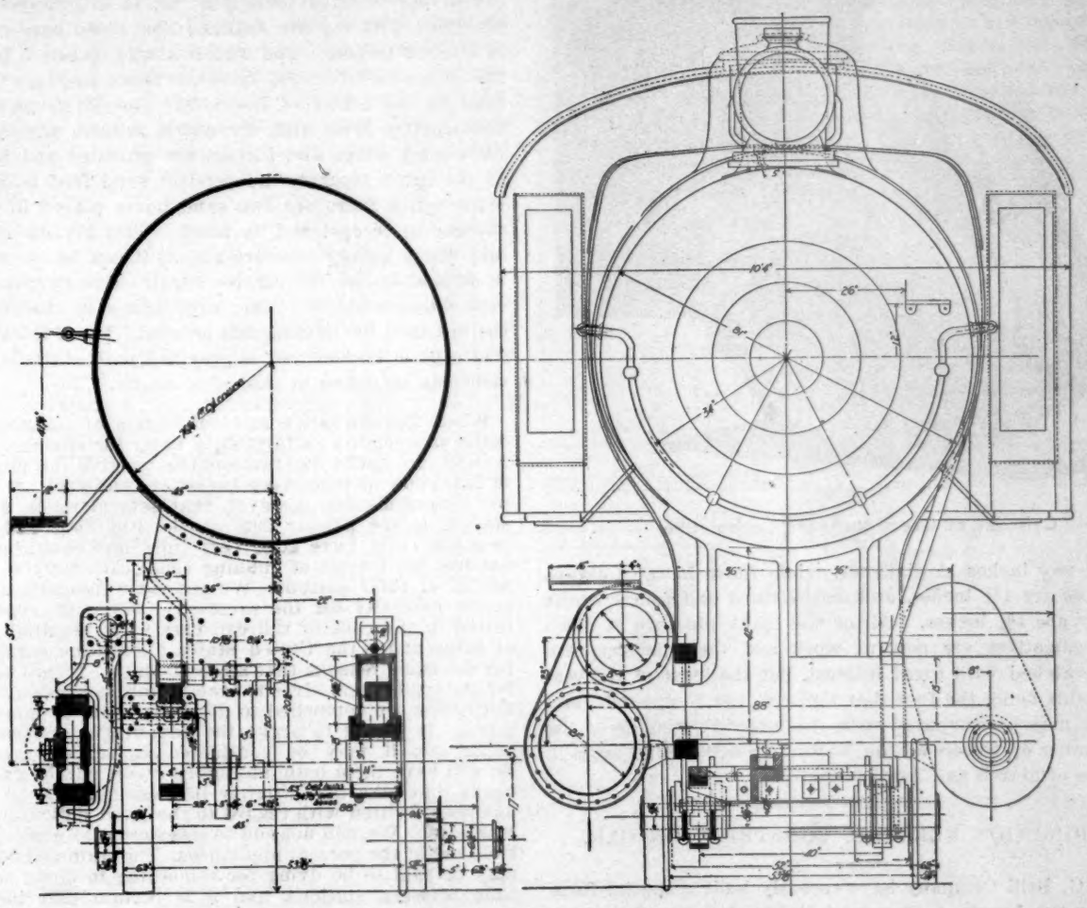
Gondola Coal Car, 80,000 Pounds Capacity, Chicago & Eastern Illinois Railroad.

Designed by T. A. Lawes, Superintendent of Motive Power.

POWERFUL SIMPLE LOCOMOTIVES FOR THE GREAT NORTHERN RAILWAY.

Last month we printed an illustrated description of one of the new Mastodon locomotives, built by the Brooks Locomotive Works, for the Great Northern Railway and now present a few additional notes with regard to the interesting design.

The chief features are the large cylinders, piston valves, also be noted that the area of the passage of the exhaust steam after passing out of the cylinder port is very large, and free escape of the exhaust steam is provided. This is an important matter with such large cylinder volumes, especially as the engines will undoubtedly be worked at a comparatively late cut off. The cylinders are provided with two-inch pop valves, as shown in the sectional view and we are informed that extra precautions were considered necessary on account of the excessively cold climate of Montana, which might



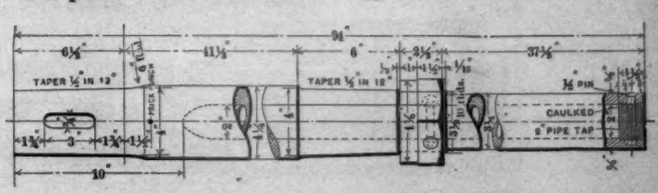
Front Elevation and Sections through Running Gear.

Powerful Simple Locomotives—Great Northern Railway.

absolutely balanced, and the extraordinary boiler capacity. These were provided for extremely severe service in the cold climate and high altitude of Montana. We are informed by the builders that the engines are to be used upon a long continuous grade of 2.2 per cent., and while the exact load to be hauled up this incline is not stated, we believe that it will be about 600 tons. At all events, the engines will be worked to their limit of capacity and it is understood that one fireman is expected to be able to take care of the fire. These engines have already been tested on an 87 foot grade, combined with curve of four degrees, out of St. Paul, over which they hauled a load of 32 cars, weighing 1,070 tons; the mean effective pressure in the cylinders being 189.5 pounds, or about 95 per cent. of the maximum boiler pressure while doing this work. The pop valves at this time were set to blow off at 200 pounds.

The form of the cylinder castings, including the valve chests with the lagging removed is shown in one of the accompanying engravings, which illustrates a half saddle with one cylinder complete. From this engraving and the longitudinal section through the cylinder and valve on page 3, of the previous issue, the very short passage of the steam from the chest to the cylinder is seen at a glance. It should cause trouble in case of careless handling. By referring again to the sectional view showing the cylinder and piston valve it will be seen that the bushings for the valves are inserted at each end of the steam chest and also that the valve stem is guided at both ends. This drawing also shows the construction of the piston and also in a general way that of the piston rod, but the rod is better illustrated in the detail drawing shown herewith.

The piston rods are hollow and 4¼ inches in diameter over

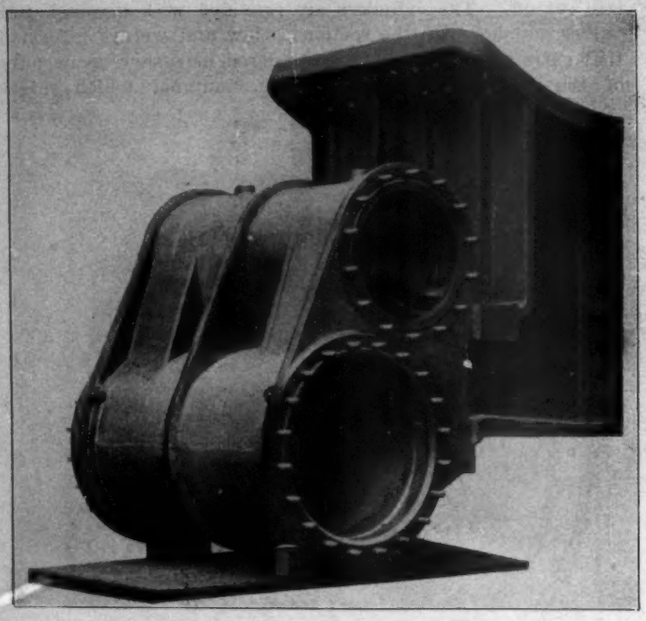


Hollow Piston Rod.

the main portion, the extended end being 3¼ inches in diamter. The length of the rod and other details of its construction with the diameter of the hole are shown in the drawing. Attention is directed to the fillet, with a six-inch radius, at the crosshead enlargement. The crossheads are made of open

hearth cast steel, with bronze gibs, the wearing surfaces of which are not tinned.

The crank pins, rocker shafts and crosshead pins are hollow. The holes in the rocker shafts and in the main crank



Cylinder of Great Northern Locomotive.

pins are two inches in diameter, while those in the forward crank pins are 1¼ inches, and in the third and fourth crank pins they are 1¾ inches. All of the crank pins are of steel.

The locomotives are now at work and their performance will be watched with great interest, not the least of the reasons for this being the fact that they are not compounds, and that they may be compared with the large compounds of the same number of wheels on the Northern Pacific, illustrated in our issues of March and April of last year.

COMBINATION ELECTRIC CONSTRUCTION CAR.

The J. G. Brill Company have recently built a special form of car for the Lorain & Cleveland Railroad Company, which

Combination Construction Car—The J. G. Brill Company.

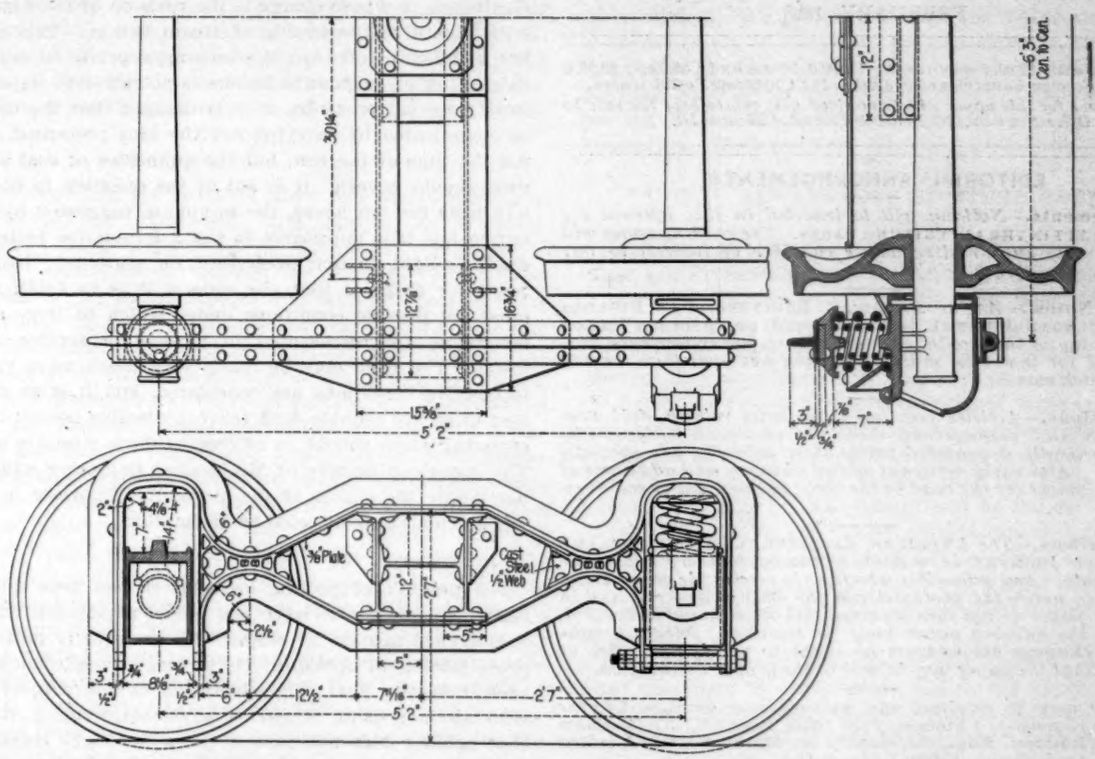
from its convenience and the fact that it may be utilized in case of necessity as a snow plow, makes it worthy of attention. The body of the car is that used in the ordinary type of construction for cars for suburban roads. It is mounted on a pair of "Perfect" Brill No. 27 trucks. At the forward end is placed a vestibule enclosed on all sides and fitted with drop sash. A canopy, carrying the trolley board, extends over the whole car. The length of the body is 24 feet, width 6 feet 1 inch; sills are of yellow pine plated 3¾ inches by 7 inches. The plates are ⅝ inch by 8 inches. The stringers are 3½ inches by 7 inches, and the flooring 1¾ inches of yellow pine. The sides are hinged, the hinges extending all the way across. The sides, which are 24 inches high, are hinged in three sections; at the rear the end drops in a single piece.

The car is fitted with four "G. E. 57" motors and it is equipped with electric brakes. The wheel base of the trucks is 5 feet 9 inches. The wheels are 33 inches in diameter and the gauge is 4 feet 8½ inches. There are two truss rods to hold up the center of the body. The car is of the ordinary construction type, and, for use in winter, a detachable nose plow with wings and fittings are provided and in the center of the car a separate independent sand feed is arranged, besides which there are two sand boxes placed in the body of the car to be operated by hand. This arrangement of plow and wings is very effective and as it can be removed when it is desired to use the car for construction purposes, makes it especially valuable. The large boxes in the center of the car are used for hauling salt or sand. There is an alarm gong and a plain arched roof is provided with curtains so that the sides can be closed in case of necessity.

When the sanitation and ventilation of passenger cars become appreciated as forming a basis for effective advertising it will no doubt be fashionable to give the proper amount of attention to these very important subjects. It is a matter for congratulation, however, that several roads, such, for instance, as the Illinois Central, the Big Four and the Chesapeake & Ohio, have gone very fully into sanitation with, we believe, the motive of running clean cars for the sake of the health of their patrons. We see clear indications of the absolute necessity for the same strictness with regard to sanitation in the case of railroad cars as is required in the case of ships under the United States quarantine regulations, and for the same reasons that apply to ships. It will be far better for the roads themselves to take up this sanitation than to wait until they are compelled to do so by State or interstate regulation. It is idle to argue the advantages of clean cars and clean air; it may be considered as settled that the public will have them both, and much credit will be gained by the roads that take the initiative in these matters. A great deal has been written with regard to the great difficulties in ventilating cars. We will not add to this except to urge the best possible use of the present appliances. The trainmen on most lines may be said to be dying for something to do to occupy their time between stations, and it is certain that they may be instructed and compelled to do much to relieve the present abominable conditions as to ventilation. It should also be said that if the disinfecting and cleaning are carefully done, the factor that renders the lack of proper ventilation most effective will be removed and the quantity of air required by each passenger will be less, and this tends to show the very great importance of the cleaning and the fumigating.

THE BLACK DIAMOND TRUCK.

A patent has just been granted to Mr. R. W. Oswald for a steel truck, known as the "Black Diamond Truck," which is controlled by the Bloomsburg Car Manufacturing Company, of Bloomsburg, Pennsylvania. The design shown in the accompanying engraving is for a 60,000-pound capacity car, and it is interchangeable with the Fox pressed steel truck. The arch bar side frame is used and the whole construction is made up from commercial shapes. The arch bars are of 5 by 3½ inch Pencoyd Ts, weighing 16 pounds per foot. The transoms are of 12-inch I-beams, or if desired channels may be used. The springs are 7 inches high, mounted upon the tops of the boxes, as shown in the drawing. For the purpose of strengthening the truck the transoms project through the side frames, and a ⅜-inch plate, 16¾ inches wide, tapered at its ends and bent to fit under the angles



The Black Diamond Steel Truck.—The Bloomsburg Car Manufacturing Co.

of the side frames, forms the connection between the transoms and the side frames. This plate is riveted to the transoms and to the Ts, as shown in the engraving.

The side elevation shows the curved shape of the side frame members which are bent at the boxes to radii of 6 inches, and are secured to steel castings having ribs, the webs being ½ inch thick. These castings bear against and are riveted to the pedestal liners which are ¾ inch thick and extend over the top of the spring seats, making an arch with a radius of 14 inches. These liners are carried to the bottom of the box openings forming the jaws, and they are secured under the boxes by the tie pieces and bolts. The brake hanger brackets are shown in the engraving and it will be noticed that an I-beam brace, 12⅞ inches long, is placed horizontally across between the transom I-beams at the ends. The transoms are also braced at the center under the center plate by a similar I-beam, somewhat longer than those at the ends.

The engraving is sufficiently clear to be understood with this brief description. These trucks have been specified on 10 gondola cars now building at the works referred to.

WASTEFULNESS OF AUXILIARY ENGINES.

In our September issue, 1897 (page 310), attention was called to the great number of auxiliary engines in warships, and comment was made upon the practice of exercising the greatest care in designing the main machinery of large power units and neglecting the smaller ones, the great number of which often renders them of great importance in a large stationary plant or on shipboard. In support of our criticism, we are pleased to quote the "Electrical World," especially as regards the desirability of better transmission of power:

"It is not an uncommon sight to see a large generating station equipped with high-class steam machinery and striving for the highest economy in operation by the use of elaborate steam-saving devices, condensers, economizers, etc., furnished with boiler-feed pumps, which consume about 150 pounds of steam per horse-power hour. This is the kind of economy that calls to mind a variety of proverbs, conspicuous among them one concerning the spigot and the bung-hole. The large source of waste in pumps of this character is frequently sufficient to bring the operating economy of the plant down to a point which is surprising alike to engineer and financier.

"The plain and effective remedy for this trouble is the use of electric-motor driven pumps, which operate at an efficiency quite approaching that of the main generating plant. Such pumps have already come into use in many of the best-designed plants, and there is no reason whatever why their use should not become practically universal in electrical-generating stations. In point of cost they compare quite favorably with the ordinary duplex-plunger steam pump, while repairs on them are both less frequent and less expensive. Their perfect control, the automatic methods that may be readily adapted to them, their high efficiency compared with other forms of boiler-feeding pumps, are all points which should be carefully considered by those designing steam plants for electric supply. To-day the only leak of any importance in the ordinarily well-designed station is in the pumps, and it would be a matter of interest in many stations showing only fair economy where a better performance could be looked for to compare the present cost of producing a given result with that which would follow the installation of electric pumps. The donkey pump, while probably the worst offender of its kind, is not the only auxiliary common in steam plants to which electric motors may be applied with satisfactory results. A case in point is in connection with the steamer Kaiser Wilhelm der Grosse, on which sixteen forced-draught blowers are operated by electric motors."

(Established 1832.)

AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

29TH YEAR. 67TH YEAR.

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE,
MORSE BUILDING.....NEW YORK

G. M. BASFORD, Editor.

FEBRUARY, 1898.

Subscription.—$2.00 *a year for the United States and Canada;* $2.50 *a year to Foreign Countries embraced in the Universal Postal Union.*
Subscriptions for this paper will be received and copies kept for sale by the Post Office News Co., 217 Dearborn Street, Chicago, Ill.

EDITORIAL ANNOUNCEMENTS.

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Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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ANNOUNCEMENT.

A series of articles on the Construction of a Modern Locomotive, by a motive power officer of one of the leading railroads of this country, will commence in our March number, and will treat the subject in a practical manner, from the ordering of the material to the testing of the finished locomotive. This will be a valuable record, based upon a wide practical experience, and as only a limited number of extra copies will be printed, you are urged to subscribe before the publication of the March issue.

The advances of recent years in regard to the power and capacity of machine tools has led to the refitting of many progressive shops and in fact the shops that have not been pretty thoroughly equipped with new tools within a few years are not to be considered as being up to the times. They certainly are not in condition to compete with well equipped shops as regards the cost of work. Several successful manufacturing establishments might be mentioned as having found it a money-saving operation to throw away a great deal of their old machinery and replace it with new, and the superior capacity of modern tools is often such as to warrant this course, even at considerable sacrifice. In arguing for the improvement of the Government plants at navy yards Mr. George W. Melville, Chief of the Bureau of Steam Engineering, in his annual report cites a case of a large firm with what was considered one of the best plants in the country, that recently broke up good tools valued at $40,000 because they were becoming antiquated, and they were replaced with new tools at an expense of $200,000. It is not necessary for all to go as far as that, but this instance serves to show the opinion in which up-to-dateness is held, and in many shops a judicious selection of old machinery could be retired with advantage.

An important suggestion with regard to the duration of locomotive boiler tests is made in another column in this issue, which seems to possess sufficient merit to warrant attention by the committee of the American Society of Mechanical Engineers, in whose charge is the revision of the code of rules with regard to the testing of steam boilers. This committee has a difficult task, but it seems appropriate to suggest that the testing of locomotive boilers is of sufficient importance to justify special provision, if it is thought that the code would be complicated by carrying out the idea presented, viz., that not the time of the test, but the quantities of coal and water used should govern. It is out of the question to run locomotive tests for ten hours, the minimum suggested by the committee, and it is impossible to run a locomotive boiler under a draft as light as that prescribed for stationary boilers. The point we make is that the code if it is to fulfill its object must not provide conditions under which so large a class of boilers as are represented in locomotive service cannot be tested. The code may be made very much more valuable if locomotive conditions are considered, and it is so difficult at best to secure reliable data from locomotive boilers that every encouragement should be offered to those who are seeking it. The American Society of Mechanical Engineers will probably not ignore the claims of the locomotive interests in this code when attention is directed to the matter.

The practice of pooling locomotives has been strongly defended by those who have had recent experience with it, and it is argued against by others who are equally entitled to express intelligent opinions. Its advocates make such a strong case, however, that a consideration of the subject by those who are not using it seems advisable, even if the opinion that pooling does not possess the advantages claimed for it, has become firmly fixed. As generally understood the term pooling is now applied to the practice of providing more engine crews than engines; the men are not assigned to particular engines, the crews and the engines being assigned to trains independently. It has long been the practice on many roads to operate one engine with more than one crew and this is considered by some as a form of pooling, although individual crews are held responsible for the condition of the engines. The greatest difference between the two systems lies in this matter of responsibility. While in pooling no individual has the permanent care of the engine such care in what may be called the multiple-crew system is given to one of the crews. Strong claims are made by the pooling system for greater mileage, a decrease in the number of engines required to do a given amount of work, the handling of heavier trains, reduced cost of repairs and mutual advantages between the railroad and the men. Pooling is also claimed to provide a satisfactory remedy against the temptation of the men to overwork for the purpose of increasing their earnings. Those who argue against pooling take up these advantages in turn and claim that they may all be obtained equally well with a proper administration of the regular crew system. They urge the importance of the idea of individual responsibility for the care of the machinery and believe that it is impossible to provide this in the pooling system. To this the advocates of pooling

reply that with solid end rods and similar provisions the enginemen may be relieved of working on the machinery itself and that individual care may be delegated to the roundhouse forces, after insisting upon reports of needed work from the men who run the engines. They also urge that enginemen when regularly assigned to engines are likely to be so careful of them as to prevent the best service from being obtained. To one viewing the discussions of the subject from an outside standpoint the following conclusion may be reached: It is important to load engines to the maximum practicable capacity, to keep them in service as continuously as possible and to maintain them at all times in the best possible condition for service, and it is believed that special conditions surrounding roads in different localities may in some cases be met by one system better than by the other. In either case the factors which form the basis of the strong claims made for pooling should be provided for, and those who do not favor pooling say that this may be done. It is clear that the advocates of pooling have, as a rule, considered what may be termed the business questions of operation, to a considerable extent, but these should be applied as thoroughly to the regular crew system before a satisfactory estimate of its value may be obtained.

The law requiring the height of draw bars above the rail to come within the limits of 31½ inches, as a minimum, and 34½ inches, as a maximum, appears to be giving considerable trouble, on account of difficulties in taking the measurements and because the limits are very narrow. It has been found that variations of one and one-quarter inches in measurements on the same coupler may be had by moving the car along a piece of ordinary yard track. Yard tracks are usually in very bad surface, and it should not surprise any one that the coupler will be depressed by a particularly soft joint. The remedy against injustice in inspections for compliance with this rule is to take the measurements upon a good piece of track. Another difficulty lies in the fact that the underframe of a car has vertical flexibility under a load, tending to deflect by sagging at the center and raising the ends, and this may be sufficient to change the height of the couplers of a car to make it exceed the maximum limit. This can only occur when the cars are raised to nearly the maximum limit when empty, and as the complaints are for cars too high rather than too low this suggestion is important. Yet another difficulty in this connection arises from the fact that a car may come within the limits if adjusted when the wheels, bearings and journals are old and the bolts are loose, and, when new parts are applied the car begins to go up and is soon too high. It is beginning to be realized that the limits are very narrow, and it is evident that care must be taken in the measurements and in the adjustments.

The committee on laboratory tests of brake shoes has done some of the most thorough, as well as difficult, investigative work ever presented to the mechanical railroad associations. There are many more investigations that should be made and it is not to be expected that the testing work is to be continued as it was begun, viz., by a committee, and yet it ought to be done by disinterested people under the direction of the committee. It casts no reflection upon the committee to suggest that the subject of friction as concerns car and truck wheels has thus far been attacked only at its edges and that there is enough left to be done to occupy the best of investigators for a long time. Besides this new shoes are continually being brought out, and it will be remembered that tests upon these were provided for when the committee was made a standing one in 1896. With the machine available also it seems too bad that it should not be used more continuously than is now possible, and a plan is being discussed that we think worthy of the thought and attention of all who have an interest in the subject. It has been suggested that the machine, now at the works of Westinghouse Air-Brake Company, be transferred to the laboratory of Purdue University at Lafayette, and it is understood that the brake shoe committee has made a formal recommendation to that effect to the executive committee of the Master Car Builders' Association and that the executive committee now has the matter under consideration. This plan has much to recommend it, and we would call attention to the great advantages of having experimental work of this kind carried on under the personal direction of Professor Goss, who has for a long time devoted so much attention to important practical railroad subjects. It is believed that this apparatus could not be placed in better hands. By setting the machine up at Purdue and placing it in charge of Professor Goss, under the proper restrictions, it is likely that the results attained will be far more valuable to the association than any that might be carried out by any other method. We understand that the University is ready to invest freely in preparing for the machine and it is believed that if the machine is placed there the Master Car Builders' Association will probably benefit as much from it as has the Master Mechanics' Association from the laboratory locomotive. We hope to see this plan carried out.

THE ADVANTAGES OF STEEL CARS.

Many railroad men, especially car builders, are shaking their heads and expressing grave doubts as to the ultimate success of the large capacity steel cars now being built. If such cars were immediately placed in interchange service we can readily see that they might be very troublesome, and it is doubtful whether they would be economical. It is proper, therefore, at the outset, in discussing the economics of large steel cars, to consider separately cars intended for special service on home roads, and those for general interchange over many roads. It now appears to be quite certain that the course steel car building will take in this country will be the development of metal cars of 80,000 and 100,000 pounds capacity, for coal and ore, stone and other heavy materials, in service on roads owning the cars, and the experience thus gained will gradually spread and demonstrate the proper construction for interchange cars.

Box cars for grain, merchandise and furniture are the principal ones used in interchange, and as the upper framing of such cars will for a long time to come be of wood, it is only the under frame which need be considered for steel construction in this service. Indeed, many car builders in the anthracite coal region are disposed to favor steel under frames for larger capacity coal cars, but they prefer wood for the upper frame. The experience with the 50-ton coal cars now in service will soon develop many points which will be useful in designing under frames for any class of cars, whether box or coal cars.

The principal item of economy in the use of steel cars is the fact that they render larger capacity possible, and produce an increase in average paying load of trains due to decrease in dead weight. It is a triumph of good design and strong material, when steel ore cars to carry 50 tons are built to weigh no more than one built of wood, having only 30 tons capacity, and this is actually true in the case of the Schoen ore car. But for coal, in order to get sufficient capacity for 100,000 pounds, a larger car will be required, and it will weigh about 40,000 pounds, as compared with 35,000 pounds for a wooden hopper car of 30 tons capacity. This increase in dead weight when cars are hauled empty has been urged as an objection to large capacity cars.

It has been a well worn argument repeatedly advanced at the Master Car Builders' conventions and in the technical press that the average load of freight cars is only 12 or 15 tons, and therefore cars of heavier dead weight could not be economical. The fact seems to have been lost sight of, that

this very average is based not on partly loaded cars, but it is kept as nigh as it is by cars running fully loaded in one direction and empty or nearly so in the other, and that the larger the capacity of the car the larger the average can be made, even if the car runs entirely empty in one direction. With existing low rates, railroad managers have arrived at the conclusion that in order to make freight traffic profitable it is necessary to increase the capacity of freight cars and decrease the proportion of dead weight to paying load. It is already demonstrated that it is easily possible to do this by steel construction, and for this reason steel car building will be a rapidly increasing industry. The advantages of cars of large capacity have been frequently stated in connection with what is called "the large car problem," and may be summarized as follows: A given tonnage is concentrated in fewer cars and shorter trains, resulting in reduced friction and atmospheric resistance, reduced empty car movement in direction opposite to heavy traffic, reduced switching service, reduced payments for car mileage and cost of inspection, reduced numbers of air brakes and couplers and an increase in traffic capacity of main line, of freight yards, side tracks and terminals. It has been estimated that in a train of 30 steel cars of large capacity there is saving in train length of 500 feet over that required for a given paying load in wooden cars.

The first cost of steel cars is higher, per car, when those of the same capacity are considered, and also per ton of capacity when cars of different capacities are compared. For example, it is understood that the 50-ton ore cars cost nearly one thousand dollars, while a 30-ton wooden hopper coal car costs about five hundred dollars, the cost per ton for the steel cars being twenty dollars, and for the wooden car sixteen dollars and sixty cents. But considering the numerous traffic advantages, the greater durability resulting in longer life and less cost of repairs, the higher priced steel car can be shown to be more economical in the end. The life of wooden cars is usually taken as about fifteen years. The probable life of the large steel cars now building is a matter of great uncertainty, the builders claiming fifty years with confidence. It is safe to assume that it will be at least thirty years, or double the life of the wooden car.

The greater strength of the material in steel cars must offer so much more resistance to the shocks and blows incidental to car service, and which have such a destructive effect upon wooden cars that they will have practically little effect upon the structure when made of steel. Any one going through a freight car repair yard must be impressed by the large amount of damaged lumber constantly being removed from cars and the quantity of new lumber required to take its place; and on all this lumber labor must be performed. Considering the destructive agencies at work in freight car service, the wooden car must be regarded as a temporary structure, requiring constant repairs and frequent renewal. It is reasonable to expect from experience of other countries with metal cars, and from the good service obtained from metal tender frames in this country, that steel cars will be permanent structures requiring few repairs and having a long life.

The average cost of repairs to wooden cars in from forty to fifty dollars per year. It ought to be safe to take the cost of repairs to steel cars of good design and construction as not exceeding twenty-five dollars per year for repairs and painting. From the figures given above we may now make an estimate of the cost per year and per ton capacity for 30 years' service of one 50-ton steel car and two 30-ton wooden hopper cars:

Wood.		Steel.	
Cost new	$500	Cost new	$1,000
Interest, 15 years at 6 per cent	450	Interest, 30 years at 6 per cent	1,800
Repairs, 15 years at $45	675	Repairs, 30 years at $25	750
	$1,625 × 2 equals 3,250		$3,550
	$\frac{3,250}{30} = \$108.33$		$\frac{3,550}{30} = 118.33$

$\frac{108.33}{30}$ equals $36.11 cost per year per ton capacity for the wooden car, and

$\frac{118.30}{50}$ equals $23.66 cost per year per ton capacity for the steel car, a difference of over 52 per cent. in favor of the steel car.

In comparing the cost of repairs necessary to cars of such widely different materials as wood and steel, we have assumed that the rough handling and slight wrecks which are so destructive to wooden cars will not make much impression on substantial steel cars.

In the matter of deterioration, there is a widespread notion that steel cars will rapidly corrode, and that this action can be compared with deterioration by rot or decay in the case of wooden cars. It is well known that the posts and sills of stock cars have had a life of only about five years, and with much of the green and sap lumber used for coal and box cars renewals are often required, on account of rot, in eight or ten years. With lumber, this form of deterioration is not preventable, at least no preserving process has been used to any extent. With steel construction, however, a successful protective coating is probably the most vital thing connected with the life of a car. The investigations on the corrosion of metal cars, made by the Eastern Railroad of France have been published in this paper (issues of March, 1897, page 80, and April, 1897, page 117), and they showed that cars in service nearly thirty years have lost about six per cent. in weight in rust, and it was recommended that metal cars should be cleaned from rust and given two coats of paint every three years. Tender frames in service on the Chicago & Northwestern Railroad after twenty years had lost by corrosion about 10 per cent., and they required few repairs. With systematic cleaning and painting with a good protective pigment, it ought to be possible to preserve the life of a steel car for thirty or forty years, or at least to a sufficient age to warrant the increased first cost over wooden cars. With the admirable work in steel car design already done, we should not expect many failures from structural weakness, but success so far as economy is concerned depends more on the prevention of corrosion than upon anything else.

Protective coatings for steel structures have been the subject of extensive investigation in recent years, and the literature on the subject is quite voluminous. We can refer to one extensive resume of the different rustless coatings, which we believe is disinterested and ought to be reliable, namely, the four papers in the Proceedings of the American Society of Mechanical Engineers, Volumes XVI. to XVIII., by Mr. M. P. Wood. There is still a disagreement among bridge engineers as to whether steel should be primed with a coat of red lead or with mineral paint. Both have strong supporters, but nearly all are agreed: 1st. That a primary coat of linseed oil, at one time quite generally used, is not a good thing, as it is liable to wrinkle up and crack off. 2d. That mineral paint for priming should be anhydrous. 3d. That the surface should be thoroughly cleaned before any coating is applied. The cars referred to as being built at Pittsburg are being painted with a patent coating, which is compised largely of asphaltum varnish. We are inclined to think that this will be too brittle and will crack off under the severe shocks and vibrations of service. While the subject is in a very unsettled state, yet if steel cars are carefully cleaned from scale and rust, and are then primed with good red lead or anhydrous iron oxide paint, and treated by the special paints for the second coat, they will be well preserved, and when repainting is required, a good, rustless coating will doubtless have been found.

From the above, it will be seen that we have abundant faith in the success of large capacity steel cars. They constitute the most important, the most revolutionary, and the most encouraging factor in the economy of freight transportation to-day.

THE ATLANTIC CITY FLYER.

We called attention in our issue of December, 1897, page 426, to the fact that some foreigners doubted the records that had been made by the Atlantic City Flyer on the Philadelphia & Reading Railroad. The subject became very interesting to those who watched the English technical press, and saw page after page given to arguments that were intended to prove that the statements with regard to that train were absurd, the basis of the contention being that such runs were impossible because they were not made in England. The trouble all came from a misunderstanding that was cleared up by the publication of Mr. Voorhees' letter in our issue referred to. We congratulate our English contemporaries that they may now devote their space to matters that are really novel, an attribute that does not apply to fast trains in this country.

Among those who did not clearly understand the reports was "The Engineer" of London, in whose columns quite a lively discussion was conducted, in which, by the way, the American locomotive did not suffer in comparison with its foreign brethren, and it was at last granted that our engines do really travel faster than English ones. After commenting in general upon the reliability of so-called "official" records, "The Engineer" says:

"In the United States our clever contemporary, the 'American Engineer and Railroad Journal,' took the trouble to apply to Mr. Theodore Voorhees, vice-president of the Philadelphia & Reading Railroad, enclosing some extracts from this journal. Mr. Voorhees' reply was published in the last issue of our contemporary which has reached this country. It is a very remarkable and suggestive communication. 'It is quite evident,' writes Mr. Voorhees, 'that the correspondents of 'The Engineer' are not familiar with the ordinary practice of reporting trains on railways in this country.' For that matter this want of familiarity is manifested by the United States technical press to the fullest possible extent, because the official report was accepted at the other side of the Atlantic without question, and would circulate still as the truth, were it not for the action we have taken. So much premised, Mr. Voorhees goes on to demolish certain pretty little edifices which have been erected to the honor and glory of the American locomotive by explaining in detail what is the ordinary practice of reporting trains. He tells us that 'It is customary for our telegraph operators to report the passing of all trains to the superintendent's office to the nearest minute in each case. On account of the exceptional speed of No. 25, an endeavor was made to report the train as accurately as possible, and, therefore, reports were given to the nearest quarter minute. These reports were according to the ordinary station clocks, which instruments are regulated by telegraph once each twenty-four hours, and, of course, are not to be considered as absolutely accurate. No one will pretend for a moment that the reports on July 5 at Meadow Tower and Atlantic City, one minute for one mile and seven-tenths, are correct. An error is manifest in that report. It is possible that errors exist in the report at other stations and on other dates.'

"This is a very satisfactory letter; we now know where we are. * * * Mr. Voorhees points out that this train has for two months accomplished its trips at the average speed of 69 miles an hour. This is a very fine performance, and one which Mr. Voorhees may justly be proud."

We may say that no record of fast trains, giving the time between given stations or mile posts is worthy of acceptance unless the time is taken by stop watches and properly checked. We thought every one knew this, and we thought every one understood the method of reporting trains in this country. The claim for this train was for making punctual runs at a rate of 69 miles an hour for two whole months. This has become history. The performance may be repeated and improved upon if necessary, for it is not believed that locomotives have ever been run as fast as it is possible to run them. "The Engineer" wishes to know how fast a locomotive can run, and why American engines can run faster than English ones? We answer they may be run as fast as it is necessary to run them, and we do not believe that American engines can run faster than English engines. Our engines are more powerful, and they pull heavy trains faster. At the present day to discuss how fast an engine can run is wasting time. The locomotive meets present day speed requirements satisfactorily, and to make it run faster is a matter of design and of the nerve of the engine runner. The boiler power of American locomotives is needed in our severe service, and the discussion has drawn attention to this as a good factor in American locomotive design. In this connection a communication by Mr. W. M. Ackworth to "The Engineer," which is reprinted in part elsewhere in this issue is interesting, particularly as it indicates that English engines are lacking in heating surface and in adhesive weight, when compared with ours. This explains why they do not pull trains as fast as ours. The communication by Mr. Ackworth concludes as follows: "But I do not think it will be claimed for any locomotive at present running in this country (England) that it can maintain 70 miles an hour with 200 tons behind it on a dead level, and there are, I believe, a good many different types of engines which can do this in the States."

It is clearly demonstrated that American locomotives actually do run faster and with heavier trains, and that the English press is convinced of this is due to Mr. Voorhees and to "The American Engineer" for the publication of this letter, which has clinched the matter and set it finally at rest. We congratulate Mr. Voorhees, ourselves and the American locomotive upon this happy conclusion.

NOTES.

At the Liverpool street station of the Great Eastern Railway the traffic was worked for 20 years by one interlocking frame with 139 levers, and latterly 1,000 trains were dealt with daily. In 20 years this frame made 76,800,000 movements, equal to 10,520 per day.

The Boston Subway is nearly completed, and the report of Chief Engineer Howard A. Carson shows the rather novel situation of a large public work in which expenditures are below the estimates. The estimates call for $5,000,000 and the expenditures amount to $4,043,313.17.

Whether to reverse a locomotive equipped with driving brakes or to rely upon the brakes alone in making quick stops has been the subject of a number of communications recently printed in the "Railroad Gazette." The discussion points very decidedly toward the use of driver brakes alone, without reversing, as the proper method of making the quickest possible stop.

In connection with the electric cabs in Paris, the following costs of various methods of locomotion made by the Compagnie Generale and published in "The Practical Engineer" are instructive: Horse cab, 15 francs (44 cents) per day; petrol cab, 13 francs (20 cents) per day; electric cab (Krieger's), 8 francs (13 cents) per day. There is an economy of 47 per cent. over the horse and 32 per cent. over the oil motor.

It is reported that Mr. Thomas A. Edison has discovered an alloy whereby cast iron is rendered tough and yet it may be cast in moulds, and replace wrought and malleable iron for many purposes. Many discoveries have been made on this line, but so far they have all lacked the commercial requisite necessary for application on a business basis. If this feature is possessed by Mr. Edison's discovery its importance is very great.

The number of locomotives in Russia at the commencement of this year (1897) was 8,123. Of these locomotives about one-eighth were compound engines. Nearly one-half of the 8,123 engines were built in Russia, and of the whole number as many as 45 per cent. were built before 1880. The fuel used on 40 per cent. of the locomotives was coal, while 32

per cent. of the engines used petroleum, and 28 per cent. wood. —"Engineering."

The Manhattan Elevated Railway, of New York, according to a statement recently made by Mr. George Gould, is to be equipped with electric traction with as little delay as possible. This is a large undertaking, as the trains now operated require over 300 steam locomotives, the annual car mileage being about 50,000,000 miles. It is expected that the lines will be extended and more tracks added in order to increase the capacity of the road.

The location of derailing switches in high speed tracks in the State of Illinois must hereafter be at least 400 feet from the fouling point whenever the conditions seem to require this. The rule has been changed to move the derails back 100 feet further because of the constantly increasing weight and speed of trains. The new rule will be carried out by Mr. W. L. Tarbet, Consulting Engineer to the Railroad and Warehouse Commission of that State.

The New York Dry Dock No. 3 has been found so badly constructed as to cast serious reflection upon the engineer in charge. The trouble recently discovered is with the sheet piling that was supposed to be driven to a depth of 47 feet or until hard bottom was reached. Much of it does not come up to this requirement, and Naval Constructor Bowles reports that some of these piles merely rest upon the mud, while others were driven from about four feet to seventeen feet in depth.

In considering the advances made in the construction of freight equipment at a recent meeting of the St. Louis Railway Club, Mr. C. B. Adams, of the Wabash R. R., gave the following table showing the increase in the ratio of load to car weights, from which the advantages of large capacity may be seen:

Year.	Weight of Car.	Weight of Load.	Total.	Load Per Cent. of Total.
1870	20,500	20,000	40,500	49.38
1880	22,000	40,000	62,000	65.52
1895	29,000	60,000	89,000	67.53

For some time the Baltimore & Ohio Southwestern Railway Company has been experimenting with crude oil for kindling fires in locomotives, in place of using cord wood, and the results obtained are reported to have been so satisfactory that it will hereafter be used on the whole line. During the month of November 1897, at the company's shops which are located at Washington, Ind., and Chillicothe, O., 1,226 fires were started with crude oil, at a cost of $17,32, or 1.41 cents per fire. To have started the same number of fires with wood the cost would have been $306, or 24.96 cents per fire. This represents a saving of $288.68, and is very satisfactory.

Novel use is made of electric motors in constructing a sewer in Worcester, Mass. The conduit is 18 feet wide by 13 feet high and inside of this is a sewer 6 feet wide, partitioned off for the treatment of sewage by chemical processes. A coffer dam was built in order to permit of the construction of the partition wall, and for this work electric scows are used for the transportation of materials. The lighting and propelling currents are carried overhead and scows take current by trolleys. The boats are 27 feet long by 5 feet beam, wth a paddle wheel in the center, driven by a motor and spocket chain. The six boats handle 12,000 bricks, 50 barrels of cement and 100 barrels of sand daily. The whole equipment utilizes second hand apparatus.

A car for the transportation of oysters in tanks of sea water has been designed and built under the direction of President A. E. Stillwell, of the Kansas City, Pittsburgh & Gulf. It will run between Port Arthur, La., and Kansas City, Mo. There are four tanks, each provided with a ventilator through the roof, and through these the car is loaded. The sides of the car, which are three inches thick, are cut for four hinged doors, made in the form of chutes, and these doors when closed are held tightly against the openings by clamps and bolts. The car has couplers for passenger trains. The capacity of the tanks is 8,200 gallons, the appearance of the car resembling a gondola coal with a roof.

A gas tube made by the Mannesman Tube Company, of New York, was tested at the Watertown Arsenal, and burst at a pressure (hydrostatic) of 5,863 pounds per square inch. The details of the test, as published in the reports of tests of metals for 1896, which has just been issued, show that the tube was 87 inches long by about 5½ inches in diameter, weighing 82 pounds. The fracture was in the form of a slit 13¼ inches long near one end of the tube.

The elastic limit was reached at 4,710 pounds per square inch. The pressure was applied by means of a reservoir cylinder placed in the Emery testing machine, the piston of this reservoir being 3.37 inches in diameter and the maximum pressure upon it was 52,300 pounds. The test was made for the United States Signal Service.

Ernest Henry Saniter, in a paper read before the Iron and Steel Institute, Cardiff, August, 1897, details an experiment made by him to ascertain how much carbon could be taken up by pure iron without melting it. Very pure iron wire 0.04 inch in diameter was heated to about 900 degrees Centigrade for varying periods in a porcelain tube full of charcoal, and at successive stages the tube was allowed to cool and a portion of the wire removed for analysis.

After seven hours' heating an analysis showed 1.64 Centigrade. After 14 hours' heating it showed 2.79 Centigrade. After 27 hours 2.95 Centigrade, of which 0.53 was graphitic carbon and 2.42 combined carbon by difference.

It was concluded that the point of saturation was reached at 2.95 per cent., of which 0.53 was in the graphitic state.—"Sparks."

The sand blast for cleaning locomotive tenders, preparatory to repainting them, is gaining favor in railroad paint shops "Engineering News" states that at the Dennison shops of the Pittsburg, Cincinnati, Chicago & St. Louis Railway, the sand blast has been used for cleaning the rust and scale from locomotive tenders for 18 months, and during this time the average cost of cleaning each tender ready for painting has been $2.50. Considering the thoroughness of the cleaning and the durability of the work which follows, Mr. A. R. Lynch, the foreman painter at these shops believes that there is no other method so economical. Similarly favorable reports come from the Erie Railroad, where crushed quartz sand or quartz and deposit sand mixed half-and-half are used with an air pressure of from 100 to 125 pounds. A tank is cleaned thoroughly in about ten hours.

The Franklin Institute, in response to a request from the Board of Health of Philadelphia, has been carrying on the most extensive investigation of the smoke nuisance ever undertaken and the results are likely to have an important bearing on the future use of bituminous coal in stationary boilers and in locomotives in use in and near large cities. One of the best features of this investigation is the total absence of any indication of the work being influenced in the interests of any manufacturer or patentee of smoke consuming appliances. A set of resolutions has been passed expressing the opinion that the smoke nuisance may be abated and the Institute in its transactions is giving an elaborate report upon the various appliances for the abatement of the smoke nuisance. When this work is complete the record will be the most valuable collection of information to be had on this important subject, and it is likely to form the basis of legislation in many cities.

The new electric locomotive built by the General Electric Company for the Hoboken Shore road made its initial trip

over the tracks of that company on January 4. It was successfully tested as to its capabilities in hauling heavily loaded freight trains between the railroad terminals and the wharves of the trans-Atlantic liners on the Hoboken side of the North River. The trial was made over a line of track about two miles long. It consisted of drawing eight loaded freight cars, weighing in all about 260 tons, over the line and back again.

In appearance the locomotive resembles that used on the Baltimore & Ohio and the New Haven & Hartford railroads. It is somewhat smaller than the one used on the Baltimore & Ohio road.

Each truck has two axles, on which are placed motors of 135 horse-power. The motor has a total horse-power of 540, and is capable of a speed of about eight miles an hour when hauling a load. The overhead trolley system is used.

When engineers held the view that the water-tube boiler was necessarily a large consumer of coal, and therefore not an economical steam generator, there was a tendency to fit a combined arrangement in some warships, so that the ordinary cylindrical boiler could be used for steaming at low power, while the major portion of installation was of the water-tube type, so that not only could the full supply of steam be got with less weight, but it could on emergency be generated from cold boilers within a brief space of time. This idea found favor in France and in one or two other countries, but few carried it out. The Dutch, however, fitted some cruisers, and one of them has just completed her speed trials with very satisfactory results. The designed full power, as stated by the "Practical Engineer," was 9,000 I. H. P., but 10,000 horse power was exceeded on trial. Two cylindrical boilers weighing 120 tons were to give 2,000 horse power, and eight of Yarrow's boilers, weighing in all 90 tons, were to develop 7,000 horse power. As a matter of fact, the latter have given nearly four times the power of the former, so that, if measured by the respective weights, the water-tube boilers proved quite ten times more efficient than the old tank boilers.

Storage batteries have been in use on the Englewood & Chicago Electric Street Railway exclusively for slightly more than one year, and its cars have just completed 400,000 miles of service. It will be remembered that this road was built in the most sold and substantial manner expressly for storage battery work. Late in 1896, a few cars from the Madison Avenue (New York City) line were put in service, but it was not until January 1, 1897, that the first lot of new cars built expressly for the road, commenced running. This number was increased as rapidly as possible, and last summer, on the heaviest days, twenty 30-foot motor cars, each with a trailer, have been required. The company owns 44 sets of batteries, and up to the present time these batteries have averaged nearly 9,500 miles of service each, the maximum beng about 13,500 miles. So far, there is no perceptible depreciation of the plates, and to all appearances they have yet a long lease of life. Nothing has been spent on maintenance account, according to the "Street Railway Journal," the Receiver, G. H. Condict, states that the entire operating expenses of the road in 1897 amount to but 8 cents per car mile, or 8½ cents including the expenses of the receivership. This is an extraordinarily low figure, even for a trolley line, and one which has never hitherto been approached in storage battery work. The cars run about 200 miles each per day, which is responsible for the low cost per car-mile of "car service" labor. Mr. Condict, who is most fair and conservative in his statements, is unwilling as yet to say positively that storage battery traction is on this road cheaper than the overhead system would be, but says that if the batteries, which, as before stated, are apparently in as good condition as when first installed, will last for 8,000 to 10,000 miles more, a distinct economy in comparison with the overhead system would be shown.

Personals.

Mr. William Voss has been appointed superintendent of the Ohio Falls Car Manufacturing Company

Mr. Benjamin Butterworth, United States Commissioner of Patents, died at Thomasville, Ga., Jan. 16.

Mr. Charles F. Means has been chosen to succeed the late Aretus Blood as agent of the Manchester Locomotive Works.

Mr. Menard K. Bowen was elected president of the Chicago City Railway Company, at the annual meeting held Jan. 15.

Mr. W. R. Ellis, formerly with the Pullman company, has been appointed superintendent of the Missouri Car Wheel Company.

Mr. G. H. Thomson, whose office is at 51 East 44th street, New York City, has been appointed Consulting Engineer to the Honduras Railroad Syndicate.

Mr. S. F. Forbes, general storekeeper of the Great Northern, has been appointed superintendent of car and machine shops of that road at St. Paul, Minn.

Mr. Edgar Van Etten, general superintendent of the New York Central & Hudson River, has been chosen president of the Randsburg Railway, of California.

Mr. S. W. Simonds has been appointed Road Foreman of Engines for the Shamokin Division of the Phiadelphia & Reading, with headquarters at Shamokin, Pa.

Gouverneur Morris, the well-known civil engineer, who was for many years engaged in railway construction and coal mining operations, died at Detroit, Mich., December 30, aged 50 years.

Mr. Robert Gillham, general manager and chief engineer of the Kansas City Pittsburg & Gulf and controlled lines, has been elected a member of the Institution of Civil Engineers of England.

It is reported that Mr. E. W. Grieves, who recently resigned the important post of superintendent of the car department of the Baltimore & Ohio has accepted a position with the Galena Oil Works.

Mr. James Meehan has been appointed superintendent of motive power and machinery of the South Carolina & Georgia, with headquarters at Charleston, S. C., in place of Mr. J. H. Green, resigned.

Mr. Charles W. McMeekin, heretofore chief engineer of the Iowa Central at Marshaltown, Ia., has resigned his position to accept a similar position with the Anaconda Mining Company, Anaconda, Mont.

Mr. John McCormick, the oldest trainmaster on the Pennsylvania, died at his home in Altoona, Pa., Dec. 29, aged 70. He was made a trainmaster on the Pennsylvania in 1852, and was retired about a year ago.

Adams Earl, one of the projectors and the first president of the Lake Erie & Western, died at Lafayette, Ind, January 15, at the age of 78 years. He built the Lafayette & Chicago, now a part of the Big Four system.

Mr. T. O. Wood, general storekeeper of the Gulf, Colorado & Santa Fe, has been appointed purchasing agent of that road, with headquarters at Galveston, Tex., vice Mr. W. E. Hodges, general purchasing agent, resigned.

Mr. H. G. Burt, third vice-president of the Chicago & Northwestern, has been selected by the Reorganization Committee of the Union Pacific as president of the new company, and will have his headquarters at Omaha, Neb

Mr. W. W. Rich, for many years chief engineer of the Minneapolis, St. Paul & Sault Ste. Marie, and formerly chief engineer

of the Wisconsin Central, has been appointed director-general of railways in China, and is now on his way to that country.

Mr. J. C. Yager has been appointed General Manager of the Wagner Palace Car Co., with office in New York City, vice J. A. Spoor, resigned, and Mr. W. O. Chase has been appointed General Superintendent, with office in Chicago, to succeed Mr. Yager.

Mr. S. W. Bretzfield has been appointed eastern secretary, in charge of the eastern business, of the Pullman Palace Car Co. Mr. Bretzfield has been connected with the New York office of the Pullman Co. for the past twenty-five years, and recently as Eastern purchasing agent.

Mr. David Sloan, since Aug. 1, 1897, acting chief engineer of the Illinois Central and Yazoo & Mississippi Valley, has been appointed chief engineer of those roads, with headquarters at Chicago. Mr. Sloan has been with Illinois Central since 1888, assistant chief engineer previous to last August.

Mr. F. Mertsheimer, superintendent of motive power and equipment of the Kansas City, Pittsburg & Gulf, has been appointed general superintendent. Mr. Mertsheimer was formerly division master mechanic on the Union Pacific, and went to the K., C., P. & G. as superintendent of motive power and equipment last summer.

Mr. J. C. Stuart, superintendent of the Galena division of the Chicago & Northwestern, has been appointed general superintendent of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at St. Paul, Minn. He has been superintendent of the Galena division since June, 1892, and was before that date for two years assistant superintendent of the Wisconsin division of the C. & N. W. From January, 1888, to June, 1890, he was chief dispatcher of the Wisconsin division.

Mr. Hiram R. McCullough, general traffic manager of the Chicago & Northwestern, was on January 4 made third vice-president of that road to succeed Mr. H. G. Burt, recently elected president of the Union Pacific. Mr. McCullough, who is 47 years of age entered railway service in October, 1876, and was for four years traveling auditor of the Illinois Central. In October, 1880, he took a position in the general freight department of the Chicago & Northwestern, and has been connected with that road ever since. He was appointed general freight agent in March, 1885, and held that position until he was made general traffic manager Oct. 1, 1896.

Mr. C. E. Barrett, who was formerly with the Missouri Car and Foundry Company, and who for the past four years has had charge of the car-seat business of Messrs. Hale & Kilburn, of Philadelphia, has been appointed contracting agent of the Barney & Smith Car Company, of Dayton, Ohio. Mr. Barrett, in conection with his new position, will push the sale of the Wheeler car seat, manufactured by the Barney & Smith people, and as he has been closely identified with the car-seat business for four years. we predict a largely increased sale for this seat, which is now the standard on many prominent railroads. The Barney & Smith Company are to be congratulated upon securing the services of Mr. Barrett, who is widely and favorably known among prominent railroad men.

Mr. John F. Wallace, who resigned as chief engineer of the Illinois Central Aug. 1, 1897, to accept the position of vice-president and general manager of the Mathieson Alkali Works, of Providence, R. I., has returned to the service of that road as assistant second vice-president, and assumed the duties of his new position January 1. The official circular announcing his appointment reads as follows: "Mr. J. F. Wallace is appointed assistant second vice-president of this company, with office at Chicago, Ill. The second assistant vice-president will have general charge of maintenance of way and structure and also make investigations from time to time, under the direction of the second vice-president, as to the practicability of effecting economies in the service, and will perform such other duties as may be assigned to him by the second vice-president or the president. The chief engineer and consulting engineer will report to the assistant second vice-president."

We regret to announce the sudden death, on December 29, at Gloucester, England, of Mr. James Platt, the head of the firm of Felding & Platt, Limited, the well-known hydraulic machine-tool builders of that city. Mr. Platt was a member of the Council of the Institution of Mechanical Engineers, member of the Institution of Civil Engineers and also of the Iron and Steel Institute. He was vice-chairman of the Board of Directors of the Gloucester Railway, Carriage and Wagon Company. the largest and best-equipped car building establishment in England. James Platt was born in Manchester, England, on February 4, 1834. He was educated and served his apprenticeship in Sowerby Bridge, Yorkshire, where his father, Mr. John Platt, was the engineer and manager of the, at that time, celebrated tool builders, Francis Berry & Sons. In 1866 he founded the firm of Felding & Platt. In 1873 he took out, with Mr. R. H. Twaddell, the first patent on a hydraulic riveting machine. This was followed by many more, and since that date he has been closely identified with the development of hydraulic machine tools. It was he who saw the need of making riveting and flanging machines of heavy power to enable boilers to be built to stand the heavy pressure, then coming into use. His most important plant in this country is that of the hydraulic tools at the Juniata shop of the Pennsylvania Railroad at Altoona. The last piece of work he conceived and designed was the building of the gigantic gantry superstructure and riveting plant for Harlan & Wolff, of Belfast, now being used for the building of the large White Star steamship "Oceanic." With this plant practically every rivet in the ship will be put in by hydraulic power. Mr. Platt always took an active part in the work of the English engineering institutions and was a regular attendant at their meetings. Few men in the English engineering world will be so much missed, he having with his tactful and genial way made so many friends. His eldest son, Mr. John Platt, is now a resident of New York.

BOOKS RECEIVED.

"The 'Power' Catechism." Compiled from the Regular Issues of "Power." 266 pp., illustrated. Standard size. 6 by 9 inches, The Power Publishing Co., New York, 1897 Price, $2.

This book contains questions and answers covering the subjects of steam engineering and the transmission of power. The arrangement of the information in the catechetical form was adopted because of its directness. It is used in the columns of "Power" because it appeals strongly to the practical man, who prefers a simple answer to a plain question to an elaborate discussion of principles. The demand for back numbers of the publication referred to led to the compilation of the information in book form, and for this purpose the matter was revised and extended. The preface states that the book is as complete as is consistent with the conciseness of this method of presentation. The subjects are as follows: Classification of boilers, boiler setting, boiler fittings and attachments, riveted joints, properties of steam, combustion and firing, boiler heating surface, safety valves, chimneys, steam piping, horse power of engines, the slide valve, the Corliss engine, engines in general, pulleys, belting, and shafting. The subjects are presented in a very concise form, and the statements seem to be well considered and reliable. It is intended for reference by those who have not the advantage of technical education, and who are not well versed in mathematics, but others will find it useful and valuable. It is well adapted to the use of those who have the care of steam engines and machinery, but it will also be at home among the books of well-informed engineers. The book is well printed and indexed.

"High Masonry Dams." By E. Sherman Gould, M. Am. Soc. C. E., Consulting Engineer for Water-works. Van Nostrand's Science Series, No. 22. D. Van Nostrand Co., New York, 1897. Price, 50 cents.

This work replaces the original No. 22 of Van Nostrand's Science Series, bearing the same title and written by Mr. John B. McMaster. The application of mathematics to this subject has been the means of introducing new methods of treatment, and the author has for a long time been convinced that it is useless to attempt to adhere to a general formula for a section of equal resistance. The basis upon which investigators of this subject have been working is a vertical section, the basis of which is a right-angled triangle, whose base is equal to two-thirds or three-quarters of the height as leading to a section of equal resistance. The author believes it wise to profit by the labors of those who have established this principle and would start his design by laying down such a triangle, giving it a practical top, in place of the theoretical apex. If the height of the dam exceeds from 80 to 100 feet, the inside face should be given a flare to increase the footing on the water side. The dangerous stresses in high dams are those of crushing, and this particular part of the designing is quite fully elaborated by the author. The maximum compressive stresses are determined at various heights in the structure with the assumptions of empty and full reservoirs, and if the sections are not satisfactory they are modified by taking account of practical considerations. After treating the theoretical side of the questions involved and establishing a practical section the author turns his attention to the execution of the work, including the necessary accessories to the dam. These features, such as spillways and waste culverts, are exceedingly important, as they have much to do with the safety of the structures, and the author's treatment appears to be able and clear. In the preface the author states that considerable additional information on the subject of dam and reservoir building is to be found in the second revised edition of the "Designing and Construction of Storage Reservoirs," which forms No. 6 of the present series. The work under review is divided into six chapters, as follows: Static stresses, unit stresses, unequally distributed unit stresses, the vertical section of high masonry dams, the construction of high masonry dams and accessories of dams. The volume is illustrated by clear diagrams, and the mathematical expressions are in simple terms.

"Report of the Tests of Metals and Other Materials for Industrial Purposes, made with the United States Testing Machine at Watertown Arsenal during the fiscal year ended June 30, 1896." Government Printing Office, 1897.

This report covers work done on gun specimens for departments of the Government and investigative tests for the Government and for private parties. Tests are recorded with reference to work on seacoast guns, and on the resistance of banded shell in rifled guns. Helical springs for 7 and 12-inch mortar carriages were tested, and considerable routine work for the Government departments was done. Among the interesting tests for private parties was a series on riveted joints for steam boilers and on bolted and riveted joints, used in building construction. These tests are recorded with special care, and they are accompanied by micrometer observations, showing the behavior of the joints in the tests. The examination of building materials was continued in the form of tests on building bricks, culvert pipes and timbers of Douglas fir and white oak. The impartiality of the testing gives the records a character which may be depended upon for accuracy and reliability. It is pleasing to note a very appreciative paragraph in the letter of transmittal, by Major J. W. Reilly, in regard to the work of Mr. J. E. Howard, C. E., who has had charge of the Watertown Arsenal testing machine since it was first installed. We are indebted to Major Reilly for a copy of the report.

"Year Book of Railway Literature, Vol. 1, 1897." Compiled by Harry Perry Robinson. The Railway Age, Chicago, 1897.

This book is the first volume of what is intended to be an annual publication putting into permanent form the addresses and articles that have appeared during the year upon the general subject of railroads. No originality is claimed for the work except that of having conceived the idea of compiling these papers and presenting them in a permanent and convenient form. This sort of literature is very valuable and heretofore it has been almost a hopeless task to search for these articles which are from very different and widely separated sources. The subjects represented are chiefly those having to do with the most recent railroad troubles, such as are connected with pooling, the labor problem as related to railroads, rates taxes, railroad capital and kindred subjects. The chief object of the book is to render this mass of information easily accessible and to this end a very satisfactory index has been included. By saying that the work is a compilation we do not wish to intimate that it is the less valuable for that reason; we think that the editor, Mr. Robinson is entitled to credit for the idea, and also for the excellent manner in which it is carried out.

"Mechanical Draft—A Practical Treatise." B. F. Sturtevant Co., Jamaica Plain, Boston, Mass. Catalogue No. 98, 385 pages. Illustrated.

This book can not be too highly commended as a valuable publication for the use of those who have to do with steam boilers. One of its primary objects is to direct attention to the work of the Sturtevant Company, which it does in an admirable way. It goes much farther than that, and in really a valuable treatise on the subject of economical steam production in which the most important factors are the combination of fuel with oxygen itself, chiefly with the first of these factors, although considerable attention is given to steam engineeering. One of the objects of the work is to present the advantages of mechanical draft, and to enable engineers to compare this with the chimney method by impartial statements. A secondary object is to show the adaptability of the Sturtevant fans. The matter is arranged with a view of rendering all necessary information available without consulting other works, and for this purpose chapters on water, steam and fuel were included. Where statements concerning the operation of the Sturtevant apparatus are given, references are included, and it is evident that special care has been taken to render the statements authoritative. The chapters in the book are as follows: Water, steam, combustion, fuels, efficiency of fuels, efficiency of steam boilers, rate of combustion, draft, chimney draft, mechanical draft, advantages of mechanical draft, the Sturtevant fans for mechanical draft, and the application of these fans. The book is the work of able engineers, who are close students of the subject, and the production is worthy of a place among the best volumes on steam making. It is well printed, handsomely illustrated and attractively bound.

"The St. Rollox Locomotive and Carriage Works of the Caledonian Railway." By Peter Livingston Dunn, Associate Member Institute of Civil Engineers (England).

This is a complete and interesting description of these important shops, including drawings of the plan and of sections of the important buildings. We are indebted to the author for a copy of the paper, which was read before the Institution of Civil Engineers in the session of 1896-1897. Mr. Dunn is now located in San Francisco.

"Proceedings of the Fifth Annual Convention of the Traveling Engineers' Association, held at Chicago, September, 1897." Edited by W. O. Thompson, Secretary, 1897.

The proceedings of this association are too well known to require more at our hands than a statement of the principal subjects of the reports and discussions recorded, which are as follows: The preparation of coal for use on locomotives. Is the brick arch an economical adjunct to a locomotive? Repairs and adjustment of air-brake equipment on the road, the Brown system of discipline, the operation of locomotive lubricators, locomotive operation as to use of steam, metallic packing, testing air brakes. These reports increase in value. The work of the association tends to improve methods of locomotive operation and the association merits encouragement, assistance and support.

"Interstate Commerce Commission." Ninth annual report of the statistics of Railways of the United States for the year ending June 30, 1896. Advance copy, without the six statistical tables. Prepared by the statistician to the Commission. Washington, Government Printing Office, 1897.

"Proceedings of the National Convention of Railroad Commissioners." Held at St. Louis, Mo., May 11 and 12, 1897. Government Printing Office, Washington, 1897.

"The Railroad Officials' Diary, 1898," is a standard size book with a page for each day of the year, each page being headed

with the date printed in bold type. The paper is good and also the binding, which is of flexible leather. The diary is sent with the compliments of the Railroad Car Journal, 132 Nassau street, New York.

"Third Annual Report of the Boston Transit Commission, for the year ending August 16, 1897."

"Mile a Minute Express Trains," by W. J. Scott. Allport Publishing Co., 79 Temple Chambers, London, E. C. 32 pp. Paper, price sixpence.

This is an account of fast trains, chiefly in England and is reprinted from "Cosmopolis," of August, 1897, with emendations and additions. It is illustrated.

"Annual Report of the Board of Regents of the Smithsonian Institution, Showing the Operation, Expenditures and Condition of the Institution to July, 1895." Government Printing Office, Washington, 1896.

Lambert Hoisting Engine Company.—A new catalogue (9¼ by 11¾ inches in size) has been received from this firm, who are manufacturers of hoisting engines and boilers, with works at Newark, N. J. The machinery shown in the pamphlet is specially intended for the use of those engaged in logging, mining, pile driving, dredging, quarrying, bridge erecting, coal handling by steam and electric hoists, and those requiring suspension cableways, traveling and stationary derricks. The managers and engineers of the Lambert Hoisting Engine Company have been identified with the design and manufacture of this special machinery ever since its inception, and they have had much to do with its development into the simple and efficient form of the present time. They have introduced the system of interchangeable construction as far as it is practicable to do so in this class of machinery, and men of experience know the value of avoiding vexatious delays which this system permits. The engravings shown in the pamphlet are taken from photographs of machines and therefore faithfully represent the product of these builders. The machines and boilers are tested at the works before shipment for the purpose of putting every machine or boiler into working order while yet in the hands of the builders. An important chapter in the catalogue explains the method of designing the parts of the machinery and gives an outline of the class of material used. The engravings throughout are excellent clear woodcuts, and no pains have been spared in giving the information needed by purchasers. This information is printed in large clear type and it appears upon the pages with the engravings, an excellent plan. The catalogue gives evidence of careful work and leaves the impression that this concern has not limited the work of its engineers. A copy of the catalogue should be obtained by everyone having to do with such machinery. The field covered is so wide that we have not space to mention the individual machines.

The Venturi Meter is described by text and illustrations in a standard size pamphlet of 38 pages recently issued by the Builders' Iron Foundry, Providence, R. I. This description presents the theory and practice of the subject, and is worthy of preservation by those who have occasion to measure quantities of liquids passing through pipes.

The Baldwin Locomotive Works have issued a valuable and attractive catalogue of narrow gauge locomotives. It contains a history of the Baldwin works, which is practically the history of the locomotive in this country. A circular stating the purposes of the volume follows the history, and under the caption "Class Designation" are a large number of vignetted half-tone engravings of narrow-guage locomotives built by this company. Information as to weights and hauling capacity are given for each design. A chapter on compound locomotives illustrates and explains the Vauclain system of compounding, and at the end of the book a large portion of space is given to locomotive details, in which locomotives and parts thereof are shown in simple line sketches with the parts numbered and listed to facilitate ordering for repairs. We must not omit to mention the general specifications for material as used by these builders. These are illustrated in detail by sketches. The book is handsomely illustrated; it is well printed and bound, and we are glad to have a copy upon our shelves.

"Key to Klondike."—In anticipation of a rush of business to the Klondike when the season opens the railroads interested are preparing their equipment and are providing facilities for transportation. For the purpose of offering reliable information with regard to the country traversed, and the method of reaching the gold region, the Northern Pacific Railway sent a representative over the different routes and has embodied the information obtained in a folder entitled, "Key to Klondike," just issued by the passenger department. The folder gives a brief history of the Klondike, describes the region itself, the methods of mining, and gives distance and time-tables of the ocean and Yukon steamers, and those via Dyea and Chilkoot Pass. Two routes are shown from Unalaska, one via St. Michaels and the other via Sitka and Fort Selkirk. The inside of the folder bears a large colored map of Alaska, with the routes plainly indicated, and in one corner is a copy of the United States placer mining laws, with instructions for making claims and taking oaths. Besides this, the folder contains much interesting information, and a number of half-tone engravings, making it a publication worth sending for by those who go and those who do not. We are glad to have a copy of it for the information it contains. The folder will be sent to any address upon application, enclosing a 2-cent stamp, to Mr. Charles S. Fee, General Passenger and Ticket Agent, Northern Pacific Railway, St. Paul, Minn.

Hilles & Jones Company, Wilmington, Del., Catalogue "O" of Machine Tools. This is a pamphlet, standard size (9 by 12 inches) of 44 pages, well illustrated with half-tone engravings. The field covered is that of the machinery required by boiler makers, bridge, car, locomotive and iron ship builders and workers of plates, bars and structural shapes. The machines illustrated are: Punches, shears, combined punches and shears, multiple punches, gate shears, special punches for fish plates, beveling shears, angle and channel straighteners, plate bending and plate straightening rolls, plate planers, vertical milling machines, riveting presses, I beam shears and coping machines and benders for I beams and channels. These machines are driven by direct connected steam engines or electric motors. They are also arranged for attachment of pulleys for belt driving. The pamphlet is not intended as a general catalogue. It presents a few of the recent designs of this firm, and exhibits the class of machinery built by them. The range of the machinery both as to character and size is wide, and it is evident that this concern has devoted a great deal of attention to the production of powerful, convenient and efficient machinery of this class.

"Endorsements of the Civil Engineering Courses of the International Correspondence Schools."—The International Correspondence Schools of Scranton, Pa., have issued a small 64-page pamphlet containing endorsements of the schools from 64 students in civil engineering. These come from 24 States and from Canada, and from them an excellent idea of the high opinion of the schools from those best able to express opinions may be had.

"Pocket Manual of its Stocks Which Paid Dividends in 1897." This is a small pamphlet giving a list of the stocks listed on the Boston and New York Stock Exchanges, with the par value of each, and the dividends paid in 1897. It is indexed and will be valuable for reference by the holders of these securities. A copy will be sent on receipt of a two-cent stamp by Leland Towle & Co., bankers and brokers, 7 Congress street, Boston.

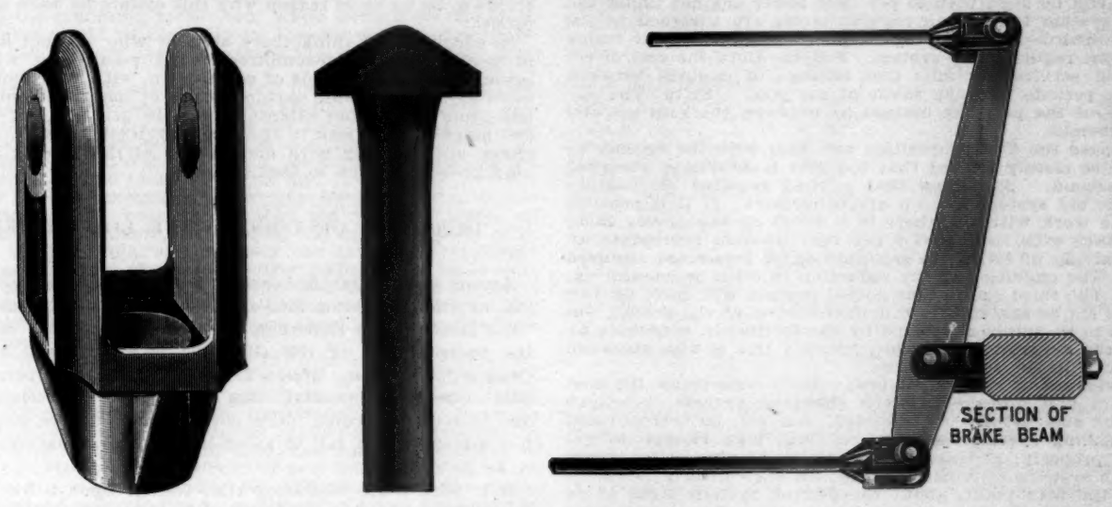
The American Railway Electric Light Company, of 14 Stone street, New York, have issued an illustrated catalogue describing the automatic railroad and house lighting systems, employing electricity as installed by them.

MALLEABLE IRON BRAKE FORKS.

The brake fork shown in the accompanying engravings was invented some time ago by Mr. T. W. Kelly of the Duluth, South Shore & Atlantic Railway, the chief object of the design being to provide a substitute for wrought iron forks, which should be at once strong and inexpensive. They are made of malleable iron by the Dayton Malleable Iron Company of Dayton, Ohio. They have been tested by a pulling stress of 40,000 pounds without fracture, which is satisfactory evidence that the design is good. There is no weld in the fork, and none in the rod with which it is connected, the

ends of the rods being upset to form a bearing in the fork as shown in the engravings. These forks are sold at a very low price, which is stated to be less than one-half the price of those of wrought iron.

Several years ago, Mr. J. J. Connolly, Master Mechanic of the road referred to, wrote the following in a letter describing his experience with these forks: "The brake fork invented by Mr. Kelly and made in malleable iron has been in use on 300 cars on this road, and we have never had a single failure: they have been tested with a pulling strain of 18 tons without a failure. They can be made for about one-half the cost of the wrought-iron fork, which should be quite an advantage to railroad companies and car manufacturers."



The Kelly Malleable Iron Brake Fork.

Mr. Kelly recently wrote us to the effect that the report by Mr. Connolly has been fully sustained and the opinion then formed has not been changed. The device has been adopted on twenty-five railroads, among which are several of the leading lines in the United States. Mr. Kelly considers the fact that the rod may be made complete without a weld, by merely upsetting the end in a bolt machine, as one of the important advantages which it possesses over wrought-iron forks. The illustrations show the method of using the forks. The head on the end of the ¾-inch rod is upset with a bevel, the large diameter of which is 15-16 inch under the head. The engraving shows the use made of the two styles of forks.

POOLING LOCOMOTIVES AND LOCOMOTIVE CREWS.*

Mr. J. F. Deems.

In the earlier days of railroading, it was the practice to assign regular engines, engine crews and train crews to all trains, in both freight and passenger service, and it was thought to be impracticable to handle the business in any other way.

This practice prevailed in some places to a considerable extent as late as 1871. It must be evident that under this system, unless the train schedules were arranged with special preference to the convenience of the locomotive department, rather than the commercial interests of the road, the earning power of locomotives might have been very limited. With the extension of railroad lines, and the increase of traffic, this method was found to be expensive and unwieldy, and as other improved facilities, chief of which was the telegraphic train dispatching, came into use, it was superseded by the system quite generally in vogue at the present time, in a modified form. The aim of the present system is to keep certain engines and engine crews together, without any reference to the trains they may haul. It is said that when this change was first suggested, it met with strong opposition from the traffic officials, who urged that it would result in much confusion on account of constant changing of crews and a direct loss in revenue due to the "personal influence" of the regular crews, where business was handled day after day by the same crew for the same shipper. This view was doubtless concurred in by the engine and train crews, because the advantages of the "personal interest" element in those good old days were possibly mutual as between shipper and crew, as well as between shipper and the railroad company. Regardless of whatever there may have been in such claims, however, the change came about, as such changes usually do, as a matter of necessity. The changed conditions seemed to meet all the requirements for many years, because the result was a largely increased output for each machine, the output being then limited by the endurance of the engine crews. The crews were too often either tempted or urged beyond the proper limit of endurance, and the results were disastrous, as is only too well known by many.

The extra list was created as a necessity, with a view to still further increasing the output of each machine, and averting the danger of overworking the engine crews. The result was quite satisfactory, in so far as there was removed the necessity of urging the crews beyond their proper limit of endurance; but the temptation, in the form of increased earnings, to overreach this limit still remained. It was still evident that too much money was invested in locomotives that were occupying stalls in round-houses when they should have been moving traffic. In order to further obviate this trouble, many experiments have been made to place two crews on each locomotive, but, except on roads where the volume of business is somewhat uniform, this system has been found unwieldy in freight service, and on lines where there is a wide fluctuation in business at different seasons of the year, its lack of flexibility seems to render it quite impracticable.

Another system of handling engine crews has been tried; it is what is known as "pooling," in which the number of engine crews assigned to a particular division, district or territory, is in excess of the number of engines. In this system the crews run, "first in, first out," without any reference to the engines to which they may be assigned for each, or for any, trip, and the engines are assigned to meet the needs of the traffic only, and quite untrammeled by any rules established to conserve the so-called "rights" of this or that man. The idea of this arrangement is to keep the engines in constant service, barring necessary repairs, and at all times to have them manned with crews that have had opportunity to secure required rest; and to regulate the number of engines and crews to meet the demands of the business so that the engines in actual service will be worked up to their capacity, and those not needed during seasons of light business may be laid up ready for any emergency. The number of crews assigned is such that they may at all times have ample rest before going out on the road, and also that they may earn a somewhat uniform rate of pay. The system is one which seems to afford sufficient flexibility to cover almost any range of fluctuation in the volume of business.

It would seem fair to assume that the best evidence of the worth, or unworthiness of this system would be the testimony of those who have tried it; and I will, therefore, beg the privilege of submitting such evidence; what follows will be based largely upon this testimony.

The letters are not reproduced here. They corroborate the statements of the author, and coming from three superintendents, two master mechanics and an engineman, a fair view of the subject is presented.

Such is the testimony—not of men who have tried it as an experiment for six months, a year, or even two years, but of men who have tested the pooling system eight or ten years as superintendents, master mechanics, engineers and foremen and after an experience extending over eight or nine years at two different points, I cannot do otherwise than emphasize what they have said. Perhaps the best way to do this is

*From a paper read before the Western Railway Club, December, 1897.

to quote some figures which were prepared for another occasion:

Year.	System of operation.	Small store.	Waste oil and tallow.	Cost per Mile. Fuel.	Wages.	Repairs.	Total.
1890....	Regular Crews	.08	.28	6.51	6.65	4.97	18 49
1893....	Pool	.10	.25	6.56	6.58	4 86	18.37

I would say in regard to these figures, that all the conditions for the two periods given were identical, with the exception that crews were assigned to certain engines, and in this case the pools had not been in operation long enough to be working properly. It showed much better results later on.

The testimony seems to show about as follows: First—It is possible to get greater mileage with the engines in a pool than under the regular crew system. Second—A given amount of work can be done with 20 per cent fewer engines under the pooling system than when regular crews are assigned to the engines. Third—An engine in the pool will haul heavier trains than in the regular crew system. Fourth—Both the cost of repairs and service per mile and mileage of engines between shopping periods show in favor of the pool. Fifth—The advantages of the pool are mutual as between the railroad and the enginemen.

I will pass the first proposition and deal with the second, as they are so closely related that the first is doubtless absorbed in the second. Assuming that a road requires 500 engines under the old system to do a given business. If it is possible to do the work with 400, there is a direct saving of say $950,000 to start with, which at 6 per cent interest represents an annual saving of $57,000, to say nothing of less room required to house the engines and the reduction in other incidental expenses. The third claim, that pooled engines will move heavier trains, is not as susceptible of demonstration as the second, but it seems to be amply supported by the testimony, especially by that of the superintendents, but possibly this is also absorbed or included in the second claim.

The evidence of the fourth proposition, concerning the cost of repairs and mileage between shopping periods, I believe cannot be successfully contradicted, and will be corroborated if the pooling system has been in force long enough to get working properly; at least my experience of nine or ten years with both systems convinces me that the statement is correct.

As to the fifth point, about the pooling system being of as much advantage to the enginemen as to the railroad company; this will probably be doubted by those who have not given the pool a thorough test, but I am sure it will be concurred in by those who have given it a thorough test.

How should such a pool be organized and operated? First, there must be the enthusiastic support of every foreman and officer who has anything to do with organizing the pool, in order to develop, as far as possible, a sentiment among the enginemen in its favor; or, at least, to allay the opposition that must be expected. The officers can profitably make a special effort to do everything possible that will add to the comfort of the enginemen, and thus contribute to overcoming this prejudice. Supposing that for a certain division forty engines are required to handle the business. A sufficient number of crews should be assigned to insure every man an opportunity to get proper rest between trips. The number will, of course, have to be adjusted from time to time, to meet fluctuations in business, and it is this elasticity of the pooling system that adapts it so perfectly to the varying conditions of traffic. Engineers and firemen should be assigned together and kept together just as though they were on regular engines. In some instances where no attempt has been made to do this, the results have not been satisfactory.

An extra list of engineers and firemen should be carried at the home division point, the same as if a "regular engine" system prevailed, so that if a man for any reason fails to go out in "his turn" an extra man can be put in the place. The regular man then waits until his turn has come again before he is "marked up" for duty, just as he would wait for "his" engine under the regular crew system.

By providing each crew (not each engine) with a suitable set of oilers, a complete check can be kept and as good mileage for oil can be made as with regular engines; these oil-cans may be left in the oil-house at the end of each trip, as is now done in some places where the regular crew system prevails. The writer can cite an instance where a division is handled under the regular crew system and an adjoining one under the pool, and the latter has shown the best oil performance month after month, the conditions being such as to make the work fairly comparable. The same is true of the fuel record.

As to the cleaning and care of engines by firemen. There seems to be no reason why firemen should be excused from this duty in the pool any more than with regular engines, providing that in either case the engine lays at a terminal long enough to receive such care. All that is necessary is to exercise care in "marking up" the engines as soon as possible so that each fireman may know what engine to care for; in case any change is made in the assignment that requires him to clean more than one engine for any one trip, he should be paid for the extra work. This has been practiced for more than two years with entire satisfaction, by paying the fireman sixty cents for each extra engine cleaned.

It may be found necessary and profitable to employ engine inspectors at principal division points where engines are pooled, and such men, if adapted to their work, can make themselves very valuable by making many light repairs; but there are instances where a pool has been run with entire success, at a point where there were from thirty to fifty engine arrivals per day and no engine inspectors were employed.

It seems to be the generally accepted theory at the present time, that the best results are obtained where it is possible to keep the engines constantly in service; this being true, it seems strange that during periods of dull business, more attention has not been given to the idea of laying up, in good condition, such engines as could be spared from service and thus keep the others in more constant use; there is little doubt that in this there is an opportunity for considerable saving, and there seems to be no way in which it can be accomplished so satisfactorily as in a pool. With the modern locomotive, equipped with solid bushed side-rods and, in some cases, main rods of the same design, with metallic steam packing at every joint, in many instances with fixed driving box wedges or liners, there seems to be no valid reason why this cannot be done with great profit.

In conclusion, I think there are few who will not agree that in years gone by locomotives were pointed to with much pride, merely as marvels of mechanism, with very limited comment on the maximum earning power of the same; but the time has come when more attention must be given to the service of the machine and less to the machine itself, merely as a machine, and possibly with more study of the pooling system it may prove a means to that end.

DURATION OF LOCOMOTIVE BOILER TESTS.

Among the written discussions submitted at the recent meeting of the American Society of Mechanical Engineers upon "The Draft of the Report of the Committee on the Revision of the Society Code of 1885, Relative to a Standard Method of Conducting Steam Boiler Trials," which were presented by title only at the meeting, was one by Professor Goss of Purdue University, which deals with a phase of the general subject which cannot fail to be of interest to locomotive men. It is as follows:

It is with some hesitation that I enter upon a discussion of a document which is the result of so much consideration as the report of this committee. It contains, however, one specification, the wisdom of which, I venture to call in question. It is that "A test should last at least 10 hours of continuous running."

I assume that this specification is intended as a safeguard against errors which are likely to appear in results derived from very short tests, and I am in sympathy with the purpose which the committee evidently had in mind in proposing it, but there are many boilers working under forced draft from which, I believe, good results may be obtained by a test of less than 10 hours' duration.

There are but two purposes to be served in prolonging a test after it has been well started; the first is to reduce the effect of the unavoidable errors incident to the starting and stopping; and the second is to allow the observations to cover so thoroughly the fluctuations in the water level, temperature of feed, steam pressure, rate of evaporation, and fire condition, that the average of the observations may be assumed to represent the average condition existing upon the boiler for the test. Errors of the first class are by far the most important, and where the conditions are favorable to the work of testing, they constitute the only ones which need be seriously considered as affecting the duration of a test. But for any given boiler, the effect of errors incident to starting and stopping is approximately proportional to the totals of the test; the effect upon the final results will not be proportional to the duration of the test, unless the rate of evaporation is always the same. With reference to this proposition, I will say that errors due to starting and stopping are likely to be somewhat larger for a boiler under high power, than for the same boiler when it is working light. Otherwise the effect of such errors would be strictly proportional to the totals of the test; but the increase in the chances of error accompanying the increase of power is not so great as to impair the value of the statement just made.

Increasing the power of the boiler, therefore, justifies a reduction in the duration of a test, because by increasing the power, the rates of evaporation and the rates of combustion are increased. Where forced draft is used, these rates become so enormously high that the tests may be made very short.

From these considerations it will appear that if other conditions are the same for each test in any given series of tests the relative degree of accuracy of the several tests becomes a function not only of duration, but of the other variables as well. Two tests, therefore, may vary greatly in duration and yet yield results having the same degree of reliability. Again, it is sometimes a fact that differences in duration are of less consequence than differences in the rate of evaporation or in the rate of combustion. In such cases the safeguard if placed on the duration, as proposed, depends upon a factor which is not of the first importance.

I present herewith for purposes of comparison, certain data, derived from a horizontal tubular boiler, and from a locomotive boiler having approximately the same extent of heating

and of grate surface. The facts concerning the tubular boiler have been selected from "Boiler Tests" by Barrus (No. 41, page 160), and those concerning the locomotive boiler have been taken from the records of the Engineering Laboratory of Purdue University.

	Tubular Boiler. (Barrus.)	Locomotive Boiler. (Purdue.)
Heating surface	1,221	1,347
Grate surface	20	17.5
Duration of test	12	3
Total water evaporated for test	19,991	34,324
Total coal fired for test	1,912	5,933
Water evaporated per foot of heating surface per hour	1.4	8.4
Coal fired per foot of grate surface per hour	8	113

Under the proposed code, the results from the tubular boiler would be accepted without question, the conditions being normal in all respects, and the duration of the test exceeding by two hours the minimum prescribed; while those from the locomotive boiler would as certainly be thrown out, the test having been run for less than one-third the minimum time prescribed.

But if judgment is based upon the totals from the test, the results from the locomotive boiler should be accepted. For this boiler the rate of evaporation per foot of heating surface was six times greater, and the rate of combustion per foot of grate surface, 14 times greater than the similar values for the tubular boiler. The totals of water and fuel for the test are far larger for the locomotive boiler than for the tubular boiler, and it has already been shown that the relative degree of reliability, other things being equal, is approximately proportional to the totals, so that with the same care exercised in each case the test of the locomotive boiler is the more reliable of the two, notwithstanding the fact that its duration is only one-fourth that of the tubular boiler, and notwithstanding the fact also that it is seven hours too short to pass muster under the proposed code.

It is not my purpose to argue in favor of a general reduction in the duration of boiler tests. I should oppose such a proposition. But I also believe that conditions are sometimes found which make a test of ten hours unreasonably long. It seems to me, therefore, that the minimum requirement should not be based directly on the length of time, but upon the quantity of water evaporated and the amount of coal burned.

I should, therefore, be glad to see substituted for the clause in the proposed code reading: "A test should last ten hours of continuous running," the following: A test should last a sufficient time to give an equivalent evaporation of not less than 15 pounds of water per square foot of heating surface, and a combustion of not less than 100 pounds of dry coal per foot of grate.

A specification in this form would meet the requirements of the case, and would be more logical than that which is proposed by the committee. For conditions common to practice with stationary boilers, the values given make the requirements which I propose, very nearly the equivalent of that which is proposed by the committee.

NEW TEN-WHEEL LOCOMOTIVES—NORTHERN PACIFIC RAILWAY.

Last month we noted the fact that the Northern Pacific Railway had ordered a number of locomotives from the Schenectady Locomotive Works. We have received tables of dimensions from Mr. E. M. Herr, Superintendent of Motive Power of the road, which are printed below. There are 24 engines in all, eight being freight compounds, eight passenger compounds and eight passenger simples. By comparison with the dimensions of the earlier engines of these types ordered of the same builders last year, and described in our issue of April, 1897, page 113, and June, 1897, page 185, it will be noted that the new ones will be almost exactly like the earlier ones, both as to freight and passenger types. The new freight engines will weigh 2,000 pounds more, the high pressure cylinders will be one inch larger in diameter and the stroke will be increased from 26 to 28 inches, but otherwise the changes are unimportant. These slight changes in the freight engines and the almost exact reproduction of the passenger engines indicate that the earlier designs must have been found satisfactory in service, and this accords with reports which we have received as to their operation.

The driving-wheel centers of the new engines are of cast steel, while the engine and tender truck wheels are the Standard wrought plate, with Northern Pacific retaining rings. The Westinghouse automatic air brake is fitted to all of the tenders, and the American brake to all of the driving wheels. All of the engines are equipped with the Westinghouse air train signal. The most important characteristics of the designs are given in the following table:

	Freight. Compound.	Passenger. Simple.	Passenger. Compound.
Type	10 wheel	10 wheel.	10 wheel.
Number ordered	8	8	8
Class	"S"	"P"	"P Compound."
Cylinders	23 and 34 by 28 in.	20 by 26 in.	22 and 34 by 26 in.
Driving wheels	63 in. dia.	69 in.	69 in.
Wheel base, total	26 ft. 3 in.	25 ft. 10 in.	25 ft. 10 in.
Wheel base, driving	14 ft. 10 in.	14 ft. 10 in.	14 ft. 10 in.
Wheel base, total	52 ft. 9½ in.	52 ft. 2 in.	52 ft. 2 in.
Weight on drivers	126,000 lbs.	112,000 lbs.	112,000 lbs.
Weight on truck	48,500 lbs.	38,600 lbs.	43,500 lbs.
Weight, total	174,500 lbs.	150,600 lbs.	155,500 lbs.
Weight, tender empty	37,800 lbs.	39,600 lbs.	39,600 lbs.
Weight, tender loaded	92,030 lbs.	94,000 lbs.	94,000 lbs.
Length over couplings	60 feet.	59 ft. 1 in.	59 ft. 1 in.
Height of stack	14 ft. 10½ in. extended wagon top.	14 ft. 9¾ in. extended wagon top.	14 ft. 9¾ in. extended wagon top.
Boiler, diam. smoke box	70 in.	62 in.	62 in.
Firebox, length	120 in.	108 in.	108 in.
Firebox, width	41 in.	41 in.	41 in.
Firebox, depth front	84 in.	76 in.	76 in.
Firebox depth, back	71½ in.	64 in.	64 in.
Tubes, number	376	314	314
Tubes, diam. of	2 inches.	2 inches.	2 inches.
Tubes, length	13 ft. 10 in.	14 ft.	14 ft.
Heating surface—			
Firebox	208 sq. ft.	168.03 sq. ft.	168.03 sq. ft.
Tubes	2,687.5 sq. ft.	2,316.97 sq. ft.	2,316.97 sq. ft.
Total	2,895.5 sq. ft.	2,485 sq ft.	2,485 sq. ft.
Tender, water capacity	4,350 gals.	4,350 gals.	4,350 gals.
Tender, coal capacity	9 tons.	9 tons.	9 tons.

The following special attachments are provided for the freight engines: Jerome metallic packing, springs by A. French & Co.; crank pins nickel steel, magnesia sectional boiler lagging, McIntosh blow-off cocks, Ashton safety valves, pneumatic sand feeding apparatus, Golmar bell ringer, M. C. B. coupler on tender, Kewanee brake beams, Allen American balanced valves, and on the passenger engines the following are used: Jerome metallic packing, springs by A. French Co., crank pins nickel steel, magnesia sectional boiler lagging, McIntosh blow-off cocks, Ashton safety valves, pneumatic sand feeding apparatus, Golmar bell ringer, Kewane brake beams. Consolidated steam heat apparatus, Mason reducing valves, Allen American balanced valves.

TONNAGE RATING.

In a paper read at the last meeting of the New York Railroad Club, Mr. L. R. Pomeroy presented an excellent, comprehensive review of the subject of tonnage rating of locomotives, which may be spoken of as having two principal objects, the first of which is to show how the rating of a locomotive on the tonnage basis may be intelligently and correctly obtained, and the other is to show how the rating should be applied in practice after it has been established. Those who are seeking a clear and concise treatment of tonnage rating will do well to read the paper.

The author divided the subject into five parts. In the first he shows that loading or rating locomotives on the car basis is unsatisfactory, because of the great variation in the loading of cars. He next demonstrates by practical examples that rating locomotives on tonnage basis is both practical and satisfactory. The third subject is the hauling capacity of locomotives. After treating of the cylinder power of the engine in its relation to the load hauled, he discusses the effect of grades, velocity and limetic energy of trains in climbing them. This part of the paper is summed up as follows:

1st. Determine the number of tons each class of engine is capable of handling in each direction over all ruling grades.

2d. Tests to be made under the most favorable circumstances, i. e., favorable weather and dry rail; the results so established, to be considered the maximum capacity of the engines, and to be considered as No. 1 rating.

3d. Provide for inferior rail, unfavorable and stormy weather, establish No. 2 and 3 ratings. This is to be done by actual tests and approximates, the results will be about as follows:

No. 2 rating equal 90 per cent. of No. 1.

No. 3 rating equal 80 per cent. of No. 2.

To the discretion of the dispatcher who receives a telegraphic report of the weather and condition of rail from all stations twice a day, is left the decision as to whether a train shall be made up to first, second or third rating, the yardmaster having standing orders to load all trains to first rating in the

absence of other instructions. There are certain exceptions, however, in the case of fast time freight and stock trains, which uniformly receive second and third rating.

Variations and Ratings to Meet Climatic and Mechanical Variables, Established and in Use on the Col., H. V. & T. R. R.

Thermometer.	Class "A" rating	Class "B" rating.	Class "C" rating.	Class "D" rating.
1. 40° and above.....	.....	94% of "A"	94% of "B"	93% of "C"
2. Bet. 30° and 40° +	94% of No. 1	94% of No. 1	94% of No. 1	94% of No. 1
3. Bet. 20° and 30° +	94% of No. 2	94% of No. 2	94% of No. 2	94% of No. 2
4. Bet. 10° and 20° +	93% of No. 3	93% of No. 3	93% of No. 3	93% of No. 3
5. Bet. 0° and 10° +	93% of No. 4	93% of No. 4	93% of No. 4	93% of No. 4
6. Bet. 0° and 10° —	85% of No. 5	85% of No. 5	85% of No. 5	85% of No. 5
7. Bet. 10° and 20° —	91% of No. 6	91% of No. 6	91% of No. 6	91% of No. 6

Class "A"—Engine out of shop 9 months.
" "B"— " " 9 to 12 months.
" "C"— " " 12 to 15 "
" "D"— " " over 15 "

The weight of cars and methods of ascertaining them are then discussed, and the author proceeds to the most important division of the subject, "Making up Trains." He says in part:

Having established the engine ratings, and inaugurated a system of reporting car weights, the next point is the making up of trains. When the train is composed wholly of loaded cars, the operation is obviously simple. But when empty cars are indiscriminately sandwiched in with the "loads," we are then confronted with the "variables" of the problem. Tests made on a certain division of one road, showed that the maximum train-load, when composed of loaded cars, was 750 tons; and when composed of empty cars, 650 tons. In both cases, care was exercised to pick out such representative loaded and empty cars as would fairly meet average conditions. It was also found that the number of cars in the train composed wholly of empty cars, exceeded that of the loaded car train by 20 cars.

The power of the engine, in each case being the same, it was assumed that the difference in the number of tons hauled (100) was due to the resistance of the increased number of cars in the "empty" train, namely, 20 cars. Dividing the 100 tons by the 20 cars, we get 5 tons as a quotient. This was assumed to represent the resistance of each car, whether loaded or empty. The real load of the empty car train then becomes: 50 cars, 13 tons each, plus 5 tons, the assumed resistance of each car, making 18 tons per car, or a total of 900 tons. On the the same basis the loaded car train composed of 30 cars of 25 tons each becomes by adding 5 tons to each car, as above, 900 tons, or the same weight as that of the empty car train. This 900 tons is called the "basis of loading" and the yardmasters are instructed to load trains to 900 tons, including weight of load and car; five tons to be added to each car in the train so made up. It is claimed that this manner of loading not only allows for empty and loaded cars, but also for partially loaded cars.

The basis of loading, i. e., 900 tons, and the resistance per car, 5 tons, varies with the physical conditions of the road, necessitating similar trials for other divisions where the conditions differ.

Many plans in use, assume the resistance per ton, on a level, for empty cars, due to rolling friction, to be 30 per cent. greater than that for loaded cars.

Taking the rolling friction at ordinary freight-train speeds at 6 pounds per ton (equivalent to a 3 per cent. grade), the total resistance, and hence gross weight of trains, on any two rates of grade, will be as the rate of grade per cent. plus 0.3. On grades of 0.5 and 1.0 per cent. adding 0.3 to each, we have 0.8 and 1.3 as the equivalent gradient in each case, including the rolling friction. The gross weight of trains, on these grades, will be as 0.8 is to 1.3 or 1 to 1.625 and not as 0.5 to 1 or 1 to 2, consequently as the grades are higher the comparative gross weight of trains comes nearer and nearer to the grade resistance only, as is but natural, since the rolling friction becomes less and less an important fraction of the total resistance?

If the rolling friction for loaded cars is equal to 6 pounds per ton, and that of empty cars is 30 per cent. greater, then on a level the ratio is as 6 to 7.8. But on a grade the restance due to gravity being common to both empty and loaded cars, the ratio becomes: As the [(grade % × 20) + 6] is to [(grade % × 20) + 7.8] or for a 1 per cent. grade, as 26 is to 27.8 (or 1:1.07) and not as 6 is to 7.8 (or 1:1.30).

A chart, Fig. 1, somewhat on the forgoing lines, has been worked out by Mr. Tracy Lyon, Master Mechanic of the Chicago Great Western Railway, which is intended to show at a glance the amount of deduction from the rating for each empty car, varying as the ratings of the several classes of engines change, from high to low ratings; being greater for a high rating than for a low one, as the lower the rating for any given engine, the greater the grade is assumed to be that produces this lower rating. This, in the writer's opinion, is a much simpler form than the Northern Pacific Railroad chart, as such

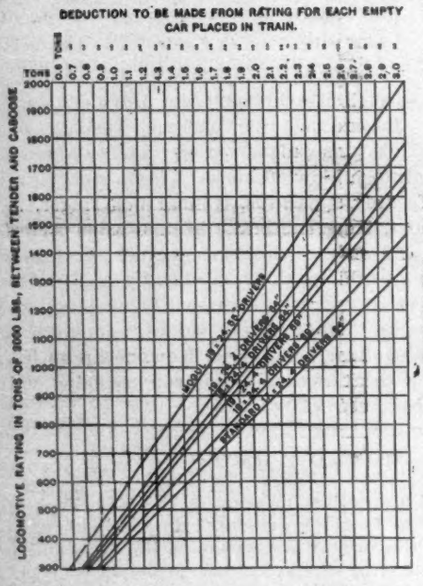

DEDUCTION TO BE MADE FROM RATING FOR EACH EMPTY CAR PLACED IN TRAIN.
LOCOMOTIVE RATING IN TONS OF 2000 LBS., BETWEEN TENDER AND CABOOSE

Fig. 1.

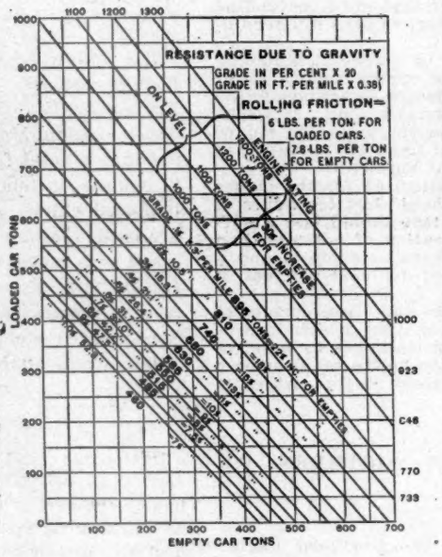

RESISTANCE DUE TO GRAVITY
GRADE IN PER CENT X 20
GRADE IN FT. PER MILE X 0.38
ROLLING FRICTION=
6 LBS. PER TON FOR LOADED CARS.
7.8 LBS. PER TON FOR EMPTY CARS.
ON LEVEL
ENGINE RATING
LOADED TONS
EMPTY CAR TONS

Fig. 2.

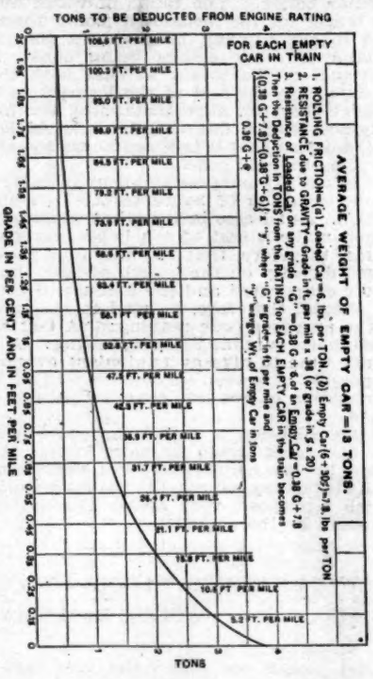

TONS TO BE DEDUCTED FROM ENGINE RATING
FOR EACH EMPTY CAR IN TRAIN
AVERAGE WEIGHT OF EMPTY CAR =18 TONS.
GRADE IN PER CENT AND IN FEET PER MILE
TONS

Fig. 3.

form will cover all the conditions of the road.

Fig. 2 is submitted in the line of a modification of the form used by the Northern Pacific Railway, by providing a diagram for each class of engine, rather than for every change in the physical conditions; the writer assuming that on most roads, at least, there would be fewer classes of engines than varieties of physical conditions. The diagram is worked out on the following plan:

Assuming a rating, the amount to be added to the empty car tonnage to equalize the increased resistance per ton of empty cars would be as follows:

On a level add.....						30 per cent
" .1 per cent. grade	5.3 feet per M.	add.....			22	"
" .2 " "	10.5 " "	.....			18	"
" .3 " "	15.8 " "	.....			15	"
" .4 " "	21.1 " "	.....			13	"
" .5 " "	26.4 " "	.....			11	"
" .6 " "	31.7 " "	.....			10	"
" .7 " "	37 0 " "	.....			9	"
" .8 " "	42.2 " "	.....			8	"
" .9 " "	47 5 " "	.....			7.5	"
" 1.0 " "	52 8 " "	.....			7	"

To illustrate the method of loading by the diagram let us assume first, a 1 per cent. grade (528. feet per mile); second, an engine rated at 460 tons; third, 300 tons of empty cars to be hauled. Query: How many tons of loads can this engine take with 300 tons of empties? As in Fig. 2 the horizontal lines represent "loaded" car-tons, and the verticals "empty" car-tons, we then follow the line at the bottom of the diagram, representing "empty car-tons" until we find 300; follow up the vertical, opposite 300, until it touches the diagonal corresponding with the rating "460," the nearest horizontal line coinciding with the vertical (300) and the diagonal (460) is 140, which shows that this particular engine can haul 300 tons of empties and 140 tons

of "loads" under the conditions described. By calculation we have 460—(300 plus 7 per cent.) equals 139.

Fig. 3 represents an effort to still further simplify the problem. It is supposed to provide one form of diagram for all conditions, but doing away with the diagonal lines which represent different classes of engines. We have assumed the average weight of empty cars to be 13 tons. On this basis the number of tons to be deducted from any rating for each empty car in the train, for any conditions, from a level to a 2 per cent. grade, can be read off on the left of the diagram. Of course 13 tons is an arbitrary weight, but any other factor can be chosen or several curves can be plotted on the same diagram representing 11, 13, 15 or any other number of tons.

THE BRACKIN PIPE WRENCH.

The Brackin Manufacturing Company, of Cleveland, O., are placing a new pipe wrench on the market. The construction and operation of the wrench are shown in the accompanying illustrations, of which one shows the tool complete, the other shows four working parts, indicating the distribution of theh strains. One of the objects of this invention is to provide a pipe wrench having a stationary jaw with a yoke firmly secured thereto and provided with a movable drop jaw so constructed that the fulcrum of bearing of the movable jaw will occur at that point of the wrench where the stock is the strongest. The makers in constructing this new tool for its special work have made durability and strength a prime feature. The jaws and pawl are drop forged from tool steel, special attention being given to tempering. The yoke and lever are drop forged from machinery steel. The surface of the lever which comes in contact with the end of the pawl is case-hardened, and the fulcrum rivet, in the under side of the arched portion of the yoke, is tempered.

The Brackin Pipe Wrench.

The method of construction, together with care in manufacture, form the basis for the claim that this wrench will work satisfactorily without locking upon or crushing the pipe. The parts are simple, few in number and accurate in operation. Adjustment is readily made. By means of the pawl thumb piece, the teeth are disengaged, and the jaw being released can easily be moved in or out. To operate in close quarters or to adjust for a small pipe, it is only necessary to push on the lever, resting the jaw on the floor or against the pipe, when it adjusts by the ratchet movement. This method shows how easily the wrench can be used with one hand. The object of the pawl thumb piece is merely to disengage the ratchet teeth. It bears no strain, as this is on the pawl, and not on the disks in the side openings of the yoke. This is demonstrated by taking the four working parts, without yoke and rivets, and placing them on a pipe in proper position, as in the engraving. The manufacturers state that the grip is as secure as if the yoke and rivets were in place; the parts will remain intact and turn the pipe, showing how well the lock joint principle has been worked out and how perfectly is the distribution of the strain.

The Baltimore & Ohio Railroad now runs its freight trains over its own tracks into New York City. Years ago a line was built from Cranford Junction on the Jersey Central to St. George, Staten Island, crossing the Kill Von Kull on a long bridge and trestle, and all B. & O. freight, either inbound or outbound, was handled from that point. The recent extension of the limits of New York City has made Staten Island a part of Greater New York, and the B. & O. now enjoys the distinction of being the only line from the West, except one, which has its own rails into the city of New York.

THE NATIONAL ASSOCIATION OF MANUFACTURERS.

The third annual convention of the National Association of Manufacturers is assembling in New York as we go to press, and indications promise that it will be the event of the year for the manufacturers of the United States. There are so many inquiries as to the object, scope and purpose of the organization that we feel warranted in giving space to a brief statement of the work.

The association was formed in January, 1895, and by a gradual development it has now reached a membership of 1,000 of the most influential of the manufacturing interests of the country. The movement started with purposes of a very general character, with two objects in view, the first of which relates to the home interests of manufacturers of the United States, and the other had to do with the foreign trade.

The objects in connection with the home interests are: The conservation of the home market, the creation of a Federal Department of Commerce and Industry, the Improvement of the patent laws, the unification of railroad freight classification, the enactment of a uniform bankruptcy law and the improvement of internal waterways. The association stands for the protection of American industries, and the tariff is viewed as a business problem, and not as a matter of political capital.

No feature of the home work of the association has met with more favor than the part that has been taken in the movement for the creation of a Federal Department of Commerce and Industry, through the efforts of a strong committee of its members and by the circulation of a large amount of printed matter relating to the subject, the asssociation has done ts full share in keeping alive public interest in the matter and in making the advantages of the proposed department more widely and better understood.

The consideration of needed reform in patent laws and in the practice of the Patent Office comes naturally into the programme of the association; for no interests are touched more closely by the operation of the patent system than the manufacturers of this country.

The work which the association has been doing in the extension of the foreign trade of American manufacturers has attracted a great deal of attention, both at home and abroad. The chief features embraced by this work are:

Investigation of foreign markets, establishment of sample warehouses, improvement of the consular service, restoration of the American merchant marine, and restoration of treaties of reciprocity.

In this work, as in all else undertaken by the association, the aim is to apply practical business methods. The plans for the foreign work of the association provide for the careful investigation of possible new markets for American products, the study of trade conditions in various countries, and the ascertainment as fully as possible of the classes of American goods saleable in different markets, with the conditions of competition which must be met.

This work is preliminary and preparatory to larger undertakings in the way of establishing depots under the management of the association in such foreign trade centres as seem to offer the best opportunities for the development of larger trade. These agencies are designed to be warerooms for the display of American merchandise of every description under conditions that will secure the most favorable attention of the possible purchaser.

It is believed by the management of the association that this plan can be applied with excellent results in many foreign countries, particularly in the Latin-American trade centers. Investigations with this end in view are being conducted in several countries, and the first warehouse in the system has

been established in Caracas(Venezuela, under particularly favorable conditions, created by a special concession from the Venezuelan Government.

A series of such establishments, covering all the important trade centers abroad, will strengthen American trade interests in foreign markets to an extent that can hardly be estimated. Every such establishment will be a source of live information about foreign markets and about American goods which will be at the disposal of the foreign merchant who wishes to buy, and the American manufacturer who is seeking to sell.

This plan of promoting foreign trade has received the hearty approval and support of the foreign governments that have been established in Caracas, Venezuela, under particularly favoffered their co-operation in a practical manner.

An important feature of the work of the National Association of Manufacturers is the publication of a large amount of matter that is of general interest and value to manufacturers. The Circulars of Information issued by the Bureau of Publicity of the Association have rendered valuable aid in promoting the interests of the organization.

The association publishes a small fortnightly paper, entitled "American Trade," which conveys to its readers much information about the commerce of the world and the part which the merchants and manufacturers of the United States have therein.

The most important publication undertaken by the association is a Buyer's Directory of the members, arranged and classified in such manner as to show the business of each member, with the information that is most desired by the foreign merchant who wishes to buy American goods. This book is now in process of preparation for early publication, and a large edition will be distributed among the merchants in the English-speaking countries.

The general offices in Philadelphia, which are under the immediate direction of the President, are in close touch with a large number of correspondents in the principal centers of the world. Information and inquiries from all parts of the world come to the association as the recognized organization of those American manufacturers who are interested in foreign trade, and the distribution of this information among the members of the association results in substantial benefits.

The Bureau of Information which is conducted for the benefit of the members of the association, possesses a great amount of material regarding the trade of the world, which is placed freely at the disposal of the members. Special inquiries concerning any line of business are undertaken for members when desired. Information concerning the financial standing and general responsibility of foreign merchants is furnished without charge.

An annual fee of $50 entitles a manufacturer to membership and to all the privileges incident thereto during the period of 12 months from the date of payment. Only manufacturers are eligible for membership.

The officers of the association include a President, Treasurer and Secretary, elected by the members in the annual convention, and a Vice-President for each State. The general policy of the association is outlined in the annual convention, and specific lines of work are indicated to the Executive Committee, which includes the general officers, the vice-presidents from the 12 largest manufacturing States and four members-at-large. The address of the Philadelphia office is 1,743 North Fourth street. The New York office is 80 Times Building. The names of Mr. Charles A. Moore, John H. Converse and Mr. C. F. Quincy are well known to our readers. The first two are members of the executive committee, and Mr. Quincy is one of the vice-presidents of the association.

THE CLEANING OF TRIPLE VALVES.

We have received a communication from Mr. G. W. Rhodes, Superintendent of Motive Power of the Chicago, Burlington & Quincy Railroad, including a circular letter issued by him to his subordinates, which is of interest as showing the difficulties of carrying out the requirement of inspecting and cleaning all triple valves once in every 12 months. The showing made upon this road may seem surprising, but it is very doubtful whether it is improved upon or even approached by other roads. It is possible that cleaning triples every 12 months is more frequent than is really necessary. This limit, however, was adopted by the Master Car Builders' Association, with the approval of the men who are best versed in such matters. There is nothing to commend the practice of allowing safety appliances or any other mechanical apparatus used on railroads to run until they show that they are unfit for further service, and the subject is of such importance that we are glad to be able to show the steps taken on the Chicago, Burlington & Quincy in the interest of safety. The circular by Mr. Rhodes is dated, Aurora, January 14, 1898, and is reproduced in full as follows:

"Now that we are getting a great many air-brakes in service it is very important that they should be properly maintained. The M. C. B. rules allow triple valves to be cleaned once in 12 months. We now have on the C., B. & Q. system 16,413 freight cars equipped as of January 1, 1898, with air-brakes. To get over these once a year the whole system ought to clean 1,368 per month. The attached table shows the number of triples cleaned on the C., B. & Q., from June to December, 1897. You will observe that during December we cleaned as follows:

C., B. & Q. triples	282
System line	219
Foreign line	7
Total	508

SHOWING NUMBER TRIPLE VALVES CLEANED FOR C., B. & Q. R. R.

Months.	Chi.	Chic. Div.	Gales. Div.	St. L. Div.	E. Ia. Burl. Div.	E. Ia. Ott. Div.	W. Ia. Div.	Total.
June	80	35	29	21	35	29	21	250
July	75	50	42	36	87	16	25	331
August	109	65	40	31	98	..	23	366
September	141	67	41	27	75	7	34	392
October	175	100	30	31	50	8	46	440
November	149	29	22	24	50	4	35	313
December	162	28	18	27	21	7	19	282
Total	891	374	222	197	416	71	203	2,374
FOR SYSTEM.								
June	35	14	25	10	17	11	7	119
July	59	25	12	18	46	8	11	179
August	91	30	17	22	24	..	18	202
September	182	26	10	10	34	..	17	279
October	155	30	12	13	30	6	9	255
November	149	9	14	18	17	2	16	225
December	154	8	9	17	18	..	13	219
Total	825	142	99	108	186	27	91	1,478
FOR FOREIGN RAILROADS.								
June	1	..	..	..	..	..	9	10
July	1	..	..	..	..	..	4	5
August	..	..	..	..	5	..	2	7
September	2	..	..	..	..	..	6	8
October	3	..	..	..	2	..	3	8
November	3	..	..	..	2	..	6	11
December	..	..	..	..	..	..	7	7
Total	10	..	..	..	9	..	37	56

"If the M. C. B. Association is all right in its opinion that triples under freight cars should be cleaned at least once a year, the practice on the C., B. & Q. is very far from perfection. I wish you would again consider this question.

"The above figures do not include the triples cleaned by the Burlington & Missouri Railroad in Nebraska and those cleaned by the Missouri lines. If we assume that together they have cleaned as many as the C., B. & Q., it will still leave us considerably short of getting over our triples once a year."

THE RAILWAY SIGNALING CLUB.

The annual meeting of this club was held January 11, at the Great Northern Hotel, Chicago, President W. J. Gillingham, Jr., presiding. A number of new members were elected and the secretary reported the result of a letter ballot on the question of colors for night signals. The vote of the club stood 26 for red and green, 9 for red and white, and 3 for other systems. The club then listened to the paper of the evening on "The Signal Engineer," by W. H. Elliott, signal engineer of the Chicago, Milwaukee & St. Paul. The discussion was deferred until the next meeting. The following officers were elected for the ensuing year: president, George P. Fowle, signal engineer, Pennsylvania Railroad lines east of Pittsburgh; vice-president, W. H. Elliott; secretary, E. M. Seitz re-elected; member of the executive committee, H. M. Sperry.

Before the meeting the club visited the large interlocking plant, known as the "State Line" interlocking, at Hammond, Ind., where one hour was spent inspecting the excellent work recently finished by the contractors, the National Switch and Signal Company, of Easton, Pa. The crossings and connecting lines of the Chicago & Western Indiana, the Chicago & State Line, the New York, Chicago & St. Louis, the Chicago & Erie, the Chicago, Indianapolis & Louisville, the Chicago & Calumet Terminal, the Michigan Central and the State Line & Indiana City Railroads, are all operated from one tower with

157 working levers, and 67 spare spaces. The locking is of the well-known National type which is vertical. The machine is an exceedingly handsome and admirable piece of work and we are informed that the whole of the contract was executed in a way that is above criticism. It is worthy of note that the vertical type of locking permitted of making the tower only 16 feet 6 inches in depth, and it is difficult to see how horizontal locking could be applied to a plant of this magnitude, without exceeding practicable limits for the floor space required by the machine. Mr. Charles Hansel, Vice-President and General Manager of the National Switch and Signal Company, and Mr. H. M. Sperry, Signal Engineer and Western Agent, gave their personal attention to the work and they are to be congratulated upon the result. Over 200 trains are handled at this plant every 24 hours and the work is done by two levermen, who are also telegraph operators. Mr. J. B. Cox, Assistant Engineer of the Chicago, Hammond & Western Railroad, superintended the design and construction. We regret our inability to print a more detailed description of the plant, the information being received too late for use in this issue.

SUBJECTS FOR 1899 M. C. B. CONVENTION.

The committee on subjects charged with the duty of presenting to the convention of 1898 a list of subjects to be referred to committees and reported upon at the convention of 1899, asks the assistance of members of the association in preparing its report.

It is requested that members will, as soon as possible, send to the chairman of the committee at Williamsport, Pa., a list of subjects which they consider of sufficient importance to be investigated by the committees of the association.

In addition to this information the committee would be glad to have subjects suggested for informal discussion during the convention of 1898.

In making suggestions for subjects which are to be reported upon by the committees, it is desired that some thought be given to the subjects which have already received attention at the hands of the association through various committees. There are undoubtedly some subjects which have been investigated and which contained all the information necessary at the time for giving a comprehensive view of the same but on account of changed conditions it might be desirable to have the same subjects investigated further. The committee especially desires your consideration of this part of the matter. There are, of course, also many objects which have not yet been reported upon, an investigation of which would be of much benefit to the association.

The committee desires that you should send your suggestions to the chairman not later than March 1.

E. D. Nelson, Chairman,
Wm. McWood,
A. L. Humphrey,
Committee on Subjects.

TRACK IMPROVEMENTS ON THE GREAT NORTHERN RAILWAY.

Extensive track improvements recently made on the Montana Central division of the Great Northern Railway have been described by Mr. J. C. Patterson, maintenance of way engineer of that division, in a paper read January 8, before the Montana Society of Engineers, from which the following is taken:

The most important improvement of the year has been the continuation of the work of filling the wooden trestles between Clancy and Butte. To do this two steam shovels were engaged the entire season, and part of the time three were at work. They handled nearly half a million cubic yards from the pits to the embankments. In addition, between the same points, 17 steel bridges were erected over the Boulder river and other streams, replacing timber structures. For this latter work there were built 2,440 cubic yards of heavy granite rubble masonry foundations, requiring 816 barrels of Portland cement and 1,093 barrels of Louisville. The spans for these bridges consisted of deck and through girders of various lengths from 40 to 80 feet, the total weight of steel work being 494 tons. The locations of these bridges were distributed over about 17 miles of track and the entire work from the time of commencing the excavation for foundations of the first bridge was completed in three months and ten days with no interruption to traffic. Thus our entire line from Clancy to Butte is now free from wooden bridges, with a few exceptions which have been otherwise provided for, the old structures having been replaced by solid enbankments and steel.

One of the principal objects in carrying forward this improvement so rapidly has been to provide for the use of heavier engines in the freight service. Two such engines (see the "American Engineer of January, 1898, page 1, and also the present issue) have been constructed and are expected in a few days. They are considered the largest locomotives ever built, weighing 172,000 pounds on the drivers, and having a total weight, engine and tender, of 308,000 pounds. As a comparison, these engines weigh 40,000 pounds more on drivers, and a total of 66,000 pounds in excess of the heaviest engines now in use on the line, from which an idea of their enormous size can be obtained.

For the more rapid and economical handling of engines at terminals and coaling stations, new coal chutes have been built at Great Falls and Wolf Creek, the one at Clancy has been rebuilt and a new one is now building at Teton. These are mentioned, as they are believed to be a new departure in the means of handling coal quickly and cheaply. In brief, the coal is elevated in the original railroad car to a height sufficient to allow it to be dumped into pockets, and from these by gravity into the engine tenders. The power is furnished by gasoline engines, which I think is the first introduction into this State on a somewhat extensive scale of this economical power, and a somewhat inconsistent one too, at first thought, when the abundance of coal is considered. However, the entire operation of one of these chutes requires the labor of one man only, who takes the coal in the car from a side track and places it in a position where the fireman, by pulling a string, does the rest.

THE PENNSYLVANIA LIMITED.

The Pennsylvania has just placed in service complete new equipment for its 24 hour limited trains, between New York and Chicago. Twenty-three new cars comprise four trains, all built at the Pullman shops and the observation car "Fortuna" is the finest work ever produced by the Pullman Company. This car is the most noteworthy and contains, besides the observation room, six exclusive compartments, each finished in different colored woods and furnished to correspond. These woods are: Circassian walnut, Tobasco mahogany, English oak, rosewood, St. Jago mahogany, and one is in vermillion. The upholstery and furnishings in these rooms is wrought tapestry. The entire train is lighted by electricity from a dynamo in the baggage car, and Frost lamps are provided for emergencies. While the observation car has more novel features than the sleepers, they all are worthy of special mention, the whole equipment being the finest in use. A departure in exterior decorations consists of painting the cars in colors. They are green below the window sills and cream color above, which is a very effective, handsome combination. The lettering and ornamentation is in gold. The cars have wide vestibules.

The amount of raw materials used in the construction of an 8-driving-wheel freight locomotive of the London Northwestern Railway as figured by Mr. F. W. Webb are printed in a recent number of "Engineering," as follows:

	Pounds.
Coal	118,800
Steel scrap	63,043
Pig iron	54,215
Wrought-iron scrap	16,352
Swedish iron	14,448
Copper ingot	11,137
Coke	10,304
Spiegel	6,373
Cast-iron scrap	3,403
Limestone	2,045
Block tin	546
Lead	83
Tile zinc	76
Phosphor bronze	70
Ferro manganese	132
Red ore	120
Chrome	30
Aluminum	13
Antimony	4

The whole weight is 139 tons for the complete engine or about one-third of the total.

Mr. O. B. Shallenberger, Consulting Engineer of the Westinghouse Company, of Pittsburg, Pa., died at Colorado Springs, Jan. 25.

At the general offices of the Northern Pacific Railway over 2,000 letters are received daily containing inquiries about transportation to the great Northwest, requests for maps of the country, etc. When spring comes the road will undoubtedly be overwhelmed with business.

ANNOUNCEMENT.

A series of articles on the Construction of a Modern Locomotive, by a motive power officer of one of the leading railroads of this country, will commence in our March number, and will treat the subject in a practical manner, from the ordering of the material to the testing of the finished locomotive. This will be a valuable record, based upon a wide practical experience, and as only a limited number of extra copies will be printed, you are urged to subscribe before the publication of the March issue.

EQUIPMENT AND MANUFACTURING NOTES.

The Michigan Central is building six six-wheel switching engines at its Jackson shops.

The Brooks Locomotive Works will build five passenger locomotives for the Long Island Railroad.

The Canadian Pacific will built 25 new locomotives during the next year, probably at its own shops.

The Illinois Central has bought three locomotives which the Rogers Locomotive Works had in stock.

The Pittsburgh Locomotive & Car Works will build seven consolidation locomotives for the Seaboard Air Line.

The Schenectady Locomotive Works have received orders to build ten ten-wheel compound engines for the Boston & Maine Railroad, and five Class A engines for the Northern Pacific.

The Richmond Locomotive and Machine Works have received orders for 15 compound consolidation locomotives for the Canadian Pacific, ten 10-wheel compound and five simple engines for the Wabash.

Locomotives have been ordered from the Pittsburgh Locomotive Works by the following roads: 20 locomotives for the Chicago, Burlington & Quincy, 4 locomotives for the Hoshin Railway of Japan, 2 locomotives for the Union Railway.

The following orders have been taken for locomotives by the Rogers Locomotive Works: The St. Joseph & Grand Island, three passenger locomotives, 20 locomotives for the International & Great Northern, and ten, ten-wheel engines for the Mobile & Ohio, five for freight and five for passenger service.

The Dickson Locomotive Works have orders for two six-wheel connected saddle tank locomotives, with 10 by 16-inch cylinders, from the Delaware & Hudson Canal Company. This firm has sold one Mogul locomotive from stock to the Richmond, Petersburg & Carolina Railroad, and two of the same type to the Buffalo, Rochester & Pittsburgh.

The Baldwin Locomotive Works have received the following orders to build locomotives: One for the Cincinnati, New Orleans & Texas Pacific, five heavy compound freight locomotives for the Norfolk & Western, two consolidation locomotives for the Hokkaido Coal Mining & Railway Company, of Japan. The Terminal Railroad Association, of St. Louis, has placed an order with this firm for two six-wheel switching engines. They are also building four compound consolidation engines for the Mexican National, 5 ten-wheel freight and one Amercan passenger engine for the Charleston & Western Carolina, and three ten-wheel engines for the El Paso & Northeastern, one locomotive for the Winifrede Railroad, five Atlantic type passenger locomotives for the Wabash; they are also building five freight locomotives for the same road, two Vauclain compound locomotives, one for freight and one for passenger service for the Barranquilla Railway & Pier Company, of Colombia, S. A.

Attractive calendars for 1898 have been received from the following firms: The Ajax Metal Co., of Philadelphia; A. M. Castle & Co., of Chicago; the Magnolia Metal Co., of New York; the Ashton Valve Co., of Boston; Messrs. Bruce & Cook, of New York and William Jessop & Sons, of New York.

Jackson & Woodin have an order for 250 coal cars for the Beech Creek Railroad.

The Union Car Company has an order for 250 coal cars for the Beech Creek Railroad.

The Allison Manufacturing Company is building three cars for the Pennsylvania Salt Manufacturing Company.

Two hundred freight cars are being built at the Fort Wayne shops of the Pennsylvania lines west of Pittsburgh.

The Canadian Pacific will add 1,000 new freight cars to its equipment during 1898. These will probably all be built at the shops of the road.

The Illinois Central has ordered 100 standard Rodger ballast cars from the Rodger Ballast Car Company. They will carry 30 cubic yards of ballast and will be of 80,000 pounds capacity.

The St. Charles Car Company have received orders for the following cars: 9 for the Kalso & Slocan, 100 freight cars for the Mississippi River & Bonne Terre, and one passenger for the Centralia & Chester.

The Indiana Car & Foundry Company is building 50 flat cars for the Commerce Despatch Line, 100 stock cars for the Mather Stock Car Company. They will equip 100 cars with air-brakes and automatic couplers for the Alton Terminal Railroad.

The Missouri Car & Foundry Company have received the following orders for cars: 119 box cars for the Vandalia Line, 40 coal and 20 box cars of 60,000 pounds capacity for the El Paso & Northeastern, and 500 box cars for the Baltimore & Ohio.

The following orders have been received for cars by the Wells & French Company, of Chicago: One thousand fruit cars, with Simplex bolsters, for the Armour Company; 100 Standard ballast cars for the Southern Pacific; 13 refrigerator cars for the St. Charles Refrigerator Despatch.

The Terre Haute Car and Manufacturing Company have received orders for 500 box cars for the Chicago, Milwaukee & St. Paul. They will be 34 feet long, of 60,000 pounds capacity, equipped with Westinghouse air-brakes, Janney couplers and Chicago grain doors. They will also build 300 coal cars for the Mobile & Ohio.

The following orders have been taken for cars by the Ohio Falls Car Manufacturing Company: 100 freight cars for the Pittsburgh, Bessemer & Lake Erie, 250 coal cars for the Baltimore & Ohio Southwestern, 50 flat and 10 box cars for the Atlantic, Valdosta & Western, and 200 coal, 200 box and 100 furniture cars for the Cincinnati, New Orleans & Texas Pacific.

The Illinois Car & Equipment Company have received the following orders for cars: 200 refrigerator and 10 tank cars for the Cudahy Packing Company. They will be 36 feet 8 inches over end sills, 8 feet 10 inches over side sills and equipped with Miners' draft rigging, Westinghouse air-brakes, automatic couplers and either Simplex or American steel bolsters. They also have an order for 50 flat cars for the Hanover Construction Company, and one for the Duluth & Iron Range for 300 ore cars with National hollow brake beams; McCord journal boxes and Tower couplers; and one from the Minneapolis & St. Louis for 200 box cars.

The Barney & Smith Car Company have received orders for 500 new box cars for the Indiana, Decatur & Western.

The Michigan-Peninsular Car Company is building the following cars, 750 for the Michigan Central, 2,000 cars for the Baltimore & Ohio, 500 for the Indiana, Decatur & Western Railroad, these will be 36 feet long inside in the clear, of 60,000 pounds capacity and equipped with Westinghouse brakes, Chicago roofs, Sterlingworth-Marden brake-beams, American couplers and Detroit springs. This firm has an order for 500 coal cars from the Beech Creek Railroad, one for 50 refrigerator cars for the Hammond Refrigerator Line, and one for 500 coal cars for the Pittsburgh & Lake Erie. Four hundred cars in the last mentioned order will have Simplex bolsters and 100 will have American steel bolsters.

The Buffalo Car & Manufacturing Company has an order for 500 coal cars from the Lake Shore & Michigan Southern.

The Mt. Vernon Car Company has an order for 250 fruit cars for the Florida Central & Peninsula, and for 200 box cars for the Mobile & Ohio.

The Pullman Palace Car Company has orders for the following cars: 3,000 box cars for the Baltimore & Ohio, 750 box cars for Baltimore & Ohio and for 200 box cars for the Mobile & Ohio.

The Jackson & Sharp Company, of Wilmington, Del., has recently finished building two electric cars for the Bennington & Hoosac Falls Electric Railroad, one for the Gloucester, Essex & Beverly electric line, of Gloucester, Mass., and seven for the Syracuse & Suburban Railroad, of Syracuse, N. Y. The company has also ready for shipment one freight car for the last named road. They have completed a new car for President Henry M. Flagler, of the Florida East Coast Railroad. It is 71 feet 6 inches long, handsomely finished and is lighted with Pintsch gas.

Messrs. Neilson & Co., The Hyde Park Locomotive Works, Glasgow, Scotland, state in a recent communication to us that the designation of the firm has been changed to Neilson, Reid & Company. The constitution of the firm, however, is unchanged.

A handsome calendar for 1898 has been received from the Ashton Valve Company, of Boston. It bears an engraving in two parts with children's figures, representing "Sunshine and Shadow," which merits preservation after the calendar itself has served its intended purpose.

Judge Wheeler, of the United States Circuit Court, at New York has handed down a decision sustaining the validity of the electric railway motor suspension patent controlled by the General Electric and Westinghouse Companies and ordering an injunction against the Union Railway Company, of New York, and the Walker Company of Cleveland.

The Monarch Brake Beam Co., Lim., of Detroit, announce the appointment of Mr. Harry W. Frost, formerly Secretary and Western Business Representative of the "Railway Age" as their General Sales Agent, with headquarters at 745 Old Colony Building, Chicago. They also announce the appointment of Mr. Charles F. Pierce as their Eastern Sales Agent, with headquarters at 1203 Havemeyer Building, New York City.

The new coal plant that the Baltimore & Ohio Railroad is erecting at Sandusky, Ohio, will consist of an elevated track, to be used either with side-dump or drop bottom cars, the coal dropping into bins from which it will flow into buckets of four tons capacity, each placed upon movable platforms. Derricks of a capacity of ten tons each will lift the buckets to the vessel. There will be sixteen of these patent drop bottom buckets, they will be handled by two of the latest steam revolving derricks, and these machines will give the plant a capacity of about 300 tons of coal per hour, at a minimum cost for the work and with a slight breakage. The plant will be in operation by April 1st.

The Sessions Foundry Co., of Bristol, Conn., have recently secured a number of important contracts for iron castings for the coming year, among them being a renewal of their previous contract with the Providence Steam Engine Co., well known makers of the Greene engine. This is very heavy work, and when business is good amounts to many tons per day. The Sessions Foundry Company's business for the past year has been the largest in its history, and from present indications will be considerably larger the coming year.

The Chicago Pneumatic Tool Company is meeting with the best of encouragement in the introduction of pneumatic riveters, particularly in connection with shipbuilding, which happens to be the field into which they are being first extensively introduced. They are reported to have made a marked success already in now driving rivets as large as 1½ inches in diameter, the work being superior to squeezed and even hand riveting. This of itself is a wide field, and if the present indications are fulfilled ship plate riveting will be revolutionized.

The Bethlehem Iron Company has received an order from the United States Government for fifteen 4-inch rapid-fire guns complete with mounts. This is the first order for such equipment complete by the same concern, it having been customary to have guns forged, finished and mounted by seperate concerns.

The experience with copper sheathing on one of the coaches of the New York, New Haven & Hartford during the past year has been so satisfactory as to lead to the decision to experiment further in this direction, and experiments are to be tried with cars sheathed with aluminum sheets and aluminum bronze.

The Detroit Lubricator Company has introduced an improvement in cylinder lubricators for locomotives, which consists of taking steam from a point in the dry pipe just ahead of the throttle valve, and applying it to the oil passing through the lubricator, in order to overcome the stoppage in the cylinder pipes due to the back pressure from the steam chests while the throttle is open. By connecting the lubricator to the dry pipe, the opening of the throttle insures a pressure on the oil which is said to cause regular feeding of the lubricators. This is an improvement upon the Tippett attachment illustrated in our issue of October 1897, page 355.

Mr. Robt. Andrews, vice-president of The Safety Car Heating and Lighting Co., said a few days ago that his company could find no fault with business done in '97, despite the hard times. The company equipped 1,584 cars with the Pintsch system of lighting during the year. The work done for the United States Light House Department includes the equipping of ninety-four buoys, two beacons and two lighthouse tenders with the Pintsch light. A total of 11,112 cars are so equipped in this country and 83,500 throughout the world.

Dispatches from Philadelphia state that the Pennsylvania Railroad has placed orders for 100,000 tons of 100-pound steel rails, as follows: Pennsylvania Steel Company, 25,000; Cambria Iron Company, 25,000; Carnegie Steel Company, 30,000; Lackawanna Iron Company, 5,000, and the Illinois Steel Company, 15,000 tons.

Mr. John A. Walker, vice-president of the Joseph Dixon Crucible Company, says, in a recent communication: "The industrial triumphs of 1897 are important. In this year the business cloud passed away and another era of prosperity, hopefully of long duration, opened. Export trade was larger in the fruits of the harvest, and particularly in manufactured goods, than in the history of the country. Americans are competing in every market. American motors won the order in London. On a bridge in Holland an American firm was the lowest bidder. American steel rails go regularly to China, Japan and India. For the Dixon Company, we have shared in the general prosperity. The year has been an agreeable one, the future looks rosy to those who have eyes to see. Perhaps the outlook was never more inviting. Never were there so many roads open to wealth to those who know how to find them."

There is no novelty about oil distributing systems, which make use of piping and the force of gravity to carry lubricants from a central source of supply to the various bearings in a room full of machinery or to the bearings of a large engine, but the application of compressed air to such distribution is novel. The Q and C Company, of Chicago, has recently introduced a pneumatic lubrication system, whereby oil is forced through piping to various bearings, and by return piping, it is carried through a filter and back to the supply reservoir again. The pressure feature of the system renders it applicable in a marine engine room, where a gravity system would not work on account of the rolling of the vessel. It may also be used in places where the supply must be below the level of the bearings to be lubricated. The system is described in a circular which will be sent upon application.

The American Balance Valves manufactured by the American Balance Valve Co., of Jersey Shore, Pa., were specified for the locomotives building at the Schenectady Locomotive Works for the Northern Pacific Railway referred to elsewhere in this issue. They will also be furnished for the 8-wheel locomotives by the same builders for the Imperial Government Railway of Japan, illustrated elsewhere in this issue.

William H. Wood, engineer and builder of special machinery, Media, Pa., reports that he has recently furnished one of his hydraulic riveting and flanging plants to the Gaar Scott Co., of Richmond, Ind., and one of his patent 1,100-pound single standard steam hammers, and a hydraulic multiple punch, to the Fox Solid Pressed Steel Co., of Joliet, Ill.; also a hydraulic riveting plant to Messrs. H. B. Beach & Sons, of Hartford, Conn., and a 12-foot hydraulic riveting plant to the Dickson Locomotive and Machine Works, of Scranton, Pa. One hydraulic upsetting machine and an 18-inch horizontal hydraulic draw bench, 10-foot stroke, both for the National Tube Works of McKeesport, Pa. One 800-pound steam hammer to John Muirhead & Son, of Pittston, Pa. One 10-foot hydraulic riveting and flanging plant to the Enterprise Boiler Co., of Youngstown, Ohio. One hydraulic riveting plant for Borger Bros. & Co., of Columbus, Ohio. One hydraulic pressure pump for the Cooke Locomotive Works, of Paterson, N. J., and one of the largest hydraulic riveting plants made for the Chas. Hillman Ship and Engine Building Co., of Philadelphia, Pa.; also one 1,100-pound patent single standard steam hammers for the Du Bois Iron Works of Du Bois, Pa., and a large number of patent hydraulic automatic safety valves for the foot of accumulators and pressure reducing valves for riveting machines for a large number of firms. This list speaks well for the business that Mr. Wood is doing.

The Magnolia Metal Company has an extensive trade in the United States and Canada as well as abroad and during the past few years numerous infringement cases have arisen with those who have made fraudulent use of their trade marks and infringed their patents. An injunction was granted on December 15, 1897, by Lord Chief Justice Russell in the Queen's Bench Division of the High Court of Justice, London, England, enjoining the Tandem Smelting Syndicate, Ltd., and restraining them from passing off their metal for Magnolia metal, it being made up in such a way as to counterfeit Magnolia metal. A few months ago the Globe Engineering Co., Ltd., of Manchester (now in liquidation), shipped a quantity of metal to a firm in South Africa on an order for Magnolia metal. The metal sent to fill this order was made up into ingots to represent the well-known ingots of Magnolia Anti-Friction metal. They bore the words "Magnolia Anti-Friction Metal," but the trade mark, the magnolia flower and the words "patented June 3, 1890," were not imprinted upon them. The purchaser brought an action in the High Court of Justice, at the Manchester Assizes, against the sellers and judgment was given in his favor by the arbitrator to whom the matter was referred. The Magnolia Metal Co. has called our attention to

the matter and desires to warn the public, through our columns, against fraudulent imitations. Genuine Magnolia Anti-Friction metal is made up into bars of which the accompanying engraving shows the appearance, and the trade mark, which is also shown herewith, together with the name of the concern is always stamped on the bars and on the boxes in which they are shipped. In addition to this the following words are stamped upon the under side of each bar: "Patented June 3, 1890," and "Manufactured in the United States." The trade mark is registered in every civilized country. The company informs us that similar frauds are being perpetrated in this country, and they offer a reward of one thousand dollars for the arrest and conviction of any individual or firm infringing their trade mark or patents.

Our Directory

OF OFFICIAL CHANGES IN JANUARY.

Chicago, Peoria & St. Louis.—The office of General Manager H. W. Gays, of the Chicago, Peoria & St. Louis and the St. Louis, Chicago & St. Paul, will be transferred from Springfield, Ill., to St. Louis.

Central of Georgia.—The announcement in our last issue that J. H. McCann succeeded W. H. Stulb as Master Mechanic at Augusta, Ga., is incorrect. Mr. Stulb is succeeded by Mr. P. J. Milan.

Chicago & Northwestern.—Mr. Hiram R. McCullough has been made Third Vice-President, to succeed Mr. H. G. Burt, recently elected President of the Union Pacific.

Chicago, St. Paul, Minneapolis & Omaha.—Mr. J. C. Stuart has been appointed General Superintendent, he was formerly Superintendent of Galena division of the Chicago & Northwestern.

Gulf, Colorado & Santa Fe.—Mr. T. O. Wood has been appointed Purchasing Agent, with headquarters at Galveston, Tex., vice Mr. W. E. Hodges, General Purchasing Agent, resigned.

Holly River.—Mr. Charles M. Warner has been elected Vice-President, vice Mr. C. R. Elliottt.

Illinois Central and Yazoo & Mississippi Valley.—Mr. David Sloan has been appointed Chief Engineer of these roads.

Illinois Central.—Mr. C. A. Beck, heretofore Assistant Second Vice-President, has been appointed General Purchasing Agent, with office at Chicago, Ill. He has been succeeded by Mr. John F. Wallace, who was formerly Chief Engineer of this road.

Iowa Central.—Mr. C. W. McMeekin has resigned as Chief Engineer of this road, to accept a position with the Anaconda Copper Mining Co., at Anaconda, Mont., and the office of Chief Engineer has been abolished.

Kansas City, Pittsburg & Gulf.—Mr. F. Mertsheimer has been appointed General Superintendent. He was formerly Superintendent of Motive Power of this road.

Kansas City & Northern Connecting.—Mr. F. Mertsheimer, who was recently appointed General Superintendent of the Kansas City, Pittsburg & Gulf, has also been made General Superintendent of this road. Mr. T. C. Sherwood has resigned as General Manager to engage in other business, and the title has been assumed by Mr. Robert Gillihan, General Manager of the Kansas City, Pittsburg & Gulf.

Lawrence & Emporia.—Mr. Hiram P. Dillon has been appointed Receiver.

Leighh Valley.—Mr. Robert H. Sayre has been appointed Assistant to the President. He was formerly Second Vice-President, and is succeeded as Second Vice-President by Mr. J. B. Garrett, formerly Third Vice-President.

Louisville, Evansville & St. Louis.—Mr. Elliott Holbrook, Superintendent, with headquarters at Princeton, Ind., will in addition to his present duties assume charge of the engineering, bridge and building departments, with title of Superintendent and Chief Engineer, with office at the same place.

Maricopa & Phoenix & Salt River Valley.—Mr. C. C. McNeal has resigned as General Superintendent.

New York & Ottawa.—Mr. C. B. Hibbard has been appointed Superintendent and Master Mechanic, with headquarters at Moira, N. Y., succeeding Mr. E. La Lime, resigned.

Omaha, Kansas City & Eastern.—The following appointments and changes have been made; Mr. Robert Gillihan has been appointed General Manager and Chief Engineer, with headquarters at Kansas City, Mo.; John M. Sevin, heretofore General Manager, has been made Assistant General Manager and General Superintendent, with headquarters at Quincy, Ill.; John Voorhis has been appointed Division Master Mechanic, with office at Quincy, Ill.; E. M. Collins has been made Assistant Chief Engineer at Trenton, Mo.; C. E. Soule has beeen made Superintendent, with headquarters at Quincy, Ill.; W. N. Allen has been appointed Stationer, with office at Kansas City, Mo.

Randsburg Railway of California.—Mr. Edgar Van Etten has been chosen President. He was formerly General Superintendent of the New York Central & Hudson River.

South Carolina & Georgia.—Mr. James Meehan has been appointed Superintendent of Motive Power and Machinery, with headquarters at Charleston, S. C., in place of Mr. J. H. Green, resigned.

Southern.—Mr. A. H. Plant has been appointed Auditor, with office at No. 1300 Pennsylvania Avenue, Washington, D. C. Mr. Frank S. Gannon has issued the following general order, the offices of Mechanical Engineer, General Superintendent, Superintendent of Transportation, General Storekeeper, and Fuel Agent will be abolished, and the Chief Engineer will be relieved of the charge of maintenance of way.

St. Louis Southwestern.—The headquarters of Mr. H. G. Kelly, Chief Engineer, have been removed from Texarkana, Tex., to Tyler, Tex.

Wisconsin & Michigan.—Mr. John Bagley, Vice-President, and Mr. J. N. Faithorn, General Manager of this company have resigned their respective positions, and will be succeeded for the present by Mr. S. M. Fischer, who is President and Treasurer of the company, with headquarters at Chicago.